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September, 1959

INDUSTRIAL QUALITY CONTROL

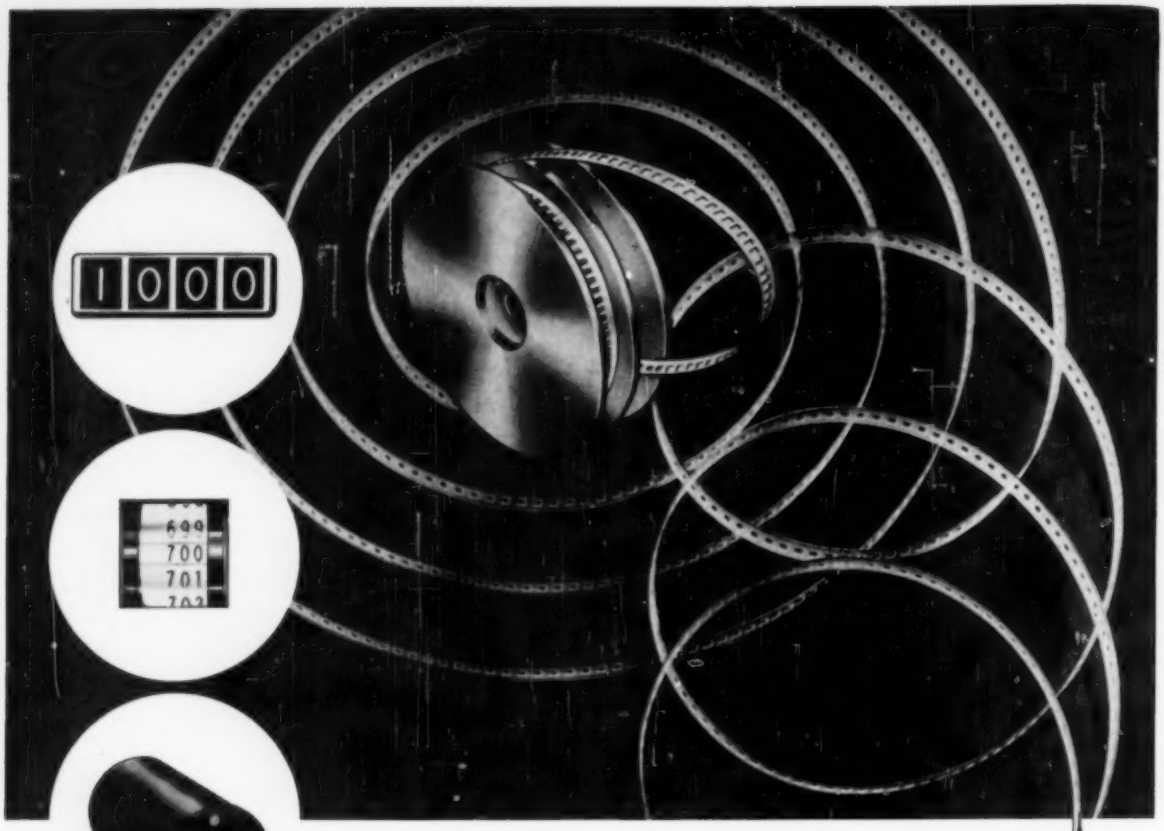
Presenting the New ASQC

Literature Classification System

Also

Test Performance Charts
Some Economic Considerations Of Inefficient Statistics

JOURNAL OF THE AMERICAN SOCIETY FOR QUALITY CONTROL



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Edwin Felch, project director in charge of developing the Titan guidance system, holds the "voice" of the ICBM.

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The command guidance system which made such accuracy possible combines precision tracking radar with a special Remington Rand Univac computer. Fed a steady stream of signals from the missile-borne transmitter, the ground-based equipment compares the missile's flight path with the preselected path. Corrective steering orders are computed and transmitted automatically to the missile. The ground station monitors the progress of the flight continuously and obtains immediate evaluation of mission success. And since the principal control equipment is kept on the ground, expendable hardware in the missile itself is minimized.

This radio-inertial guidance system is a product of the Bell Laboratories-Western Electric development-production team. It is in production at Western Electric for the first operational squadrons of the Titan intercontinental ballistic missile.

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INDUSTRIAL QUALITY CONTROL

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8 **Test Performance Charts**

FRED ENNERSON, JR., and MARK MANNING

710; 720:70:400

The authors have devised a method whereby the individual tester can monitor quality levels without waiting for performance interpretation at a later time. This monitoring is handled on a single "Test Performance Chart."

10 **Some Economic Considerations of Inefficient Statistics**

GAYLE W. McELRATH and JACOB E. BEARMAN

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Some quick and inexpensive statistical methods may be very useful and economical when the conditions do not allow lengthly and more costly statistical analysis. The authors discuss several sample statistics which can be used to estimate the same population characteristics. In addition, they consider the concept of statistical efficiency as a criterion in choosing the particular statistic which will be economically efficient in estimating the population value.

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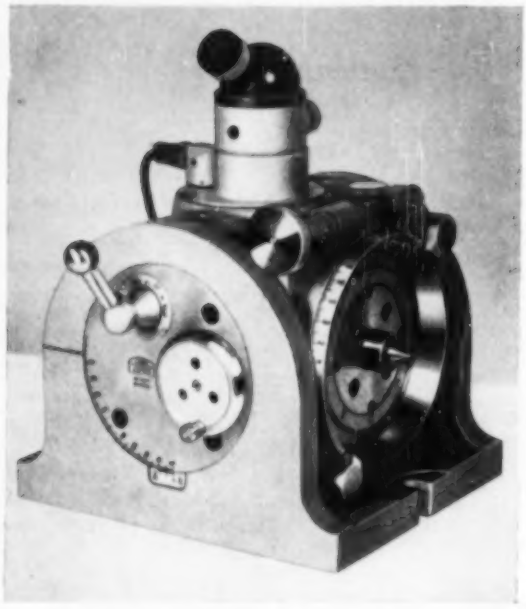
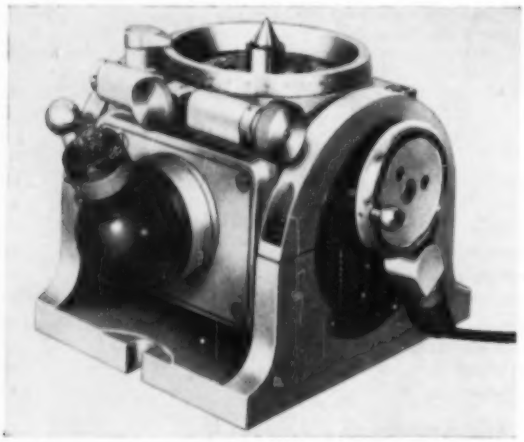


Large optical dividing head in horizontal position. Axis can be quickly changed to vertical.



Small optical dividing head in vertical position.

The large optical dividing head is a universal testing and measuring instrument for circular scales and angles. It is used in high precision machining of cogwheels, slotted and perforated discs, graduated plates, spline shafts and similar production parts. Suitable for grinding, drilling, milling and other operations.

The instrument is also suitable in testing for graduation defects and for checking the measurements of angle-measuring instruments, levels, cam plates, etc.

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COMPLETE SERVICE FACILITIES

File It

To Find It

The American Society for Quality Control

Literature Classification System

ERVIN F. TAYLOR*

Chairman, ASQC Bibliography Committee

000:00:000—A wealth of knowledge at your fingertips. The ASQC Literature Classification System is here! It works like this:

000:—The first three digits indicate the methodology or technique described by the article.

The *Methodology or Technique Classification* contains ten major categories. Each of the categories (with the exception of 000:—General) is divided into sub-groups. Some sub-groups are further divided into more detailed groups. Altogether, 820 separate subjects are available, with 119 appearing in the classification. This provides for considerable expansion of the system.

:00:—The second two digits indicate the normal functions using the method or technique described within a business or industry.

This *Functional Classification* also contains ten major categories (including :00:—General). A maximum of 100 groups are available for future expansion through subsequent subdivision. This classification includes a definition for each of the ten categories, since no suitable standard definitions could be found.

:000—The last three digits indicate a specific business or industry which uses the method or technique described.

The *Industry or Business Classification* is an adaptation of the Bureau of Census Standard Industrial Classification (SIC), universally used to code industries and businesses. Only the first two levels of the SIC are utilized. The first level is renumbered. The use of any additional levels would unnecessarily increase the complexity of the system.

Any quality control article can be classified by the three sets of digits.

Due to the varied nature of the subject matter, some articles may have more than one classification within any of the sets.

ASQC LCS Code 000:00:000
See Page 20, this issue, for Literature Classification System
*The Martin Company, Baltimore, Md.

For example, 421:60:428 indicates an article "on the properties of the normal distribution—as used in the engineering function—of a chemical manufacturing industry."

This particular article may have several different approaches. The three sets of code numbers provide an efficient cross-referencing system.

Save Time—Classify Your Personal Library

You can classify your own quality control literature according to this system. It's easy. Here's how!

1. INVENTORY—Prepare an inventory list of all articles, pamphlets, booklets, and other quality control literature you wish to include in the information pool.

This list need not be in any special order, although some logical arrangement such as numerical by date published or filed, or alphabetical by title or author is advisable.

Consecutively number each item in the inventory listing. This number is used in place of the complete title for subject cross-references.

Other information in the inventory listing should be: title, author(s), classification codes and file location. The publication, publisher, and publication date can also be included, if desired.

The inventory listing is the heart of the indexing system. It should be prepared with considerable care, and

Editorial Note

The ASQC Bibliography Committee has been working for some time on a solution to a major problem—aiding the ASQC member in locating the literature he wants from the vast quantities supplied by the ASQC.

The Committee's solution—The *ASQC Literature Classification System*—is presented here for the first time.

Each ASQC member is urged to read this article in detail and to improve his effectiveness by adopting this system for his own collection of Quality Control literature.

M. E. W.

always included regardless of the code recording method (described in 3 below) which is used.

2. CLASSIFICATION—Classify articles in order that they can be readily found.

Classification is not for the purpose of merely filing, since the inventory listing contains the file locations of all articles. Classification is for the purpose of finding.

Each article should read with this question in mind: Under what subject classifications is one likely to be looking for this article? Think also of the user for which the classification is being made. The approach to a classification for an individual's use is different from that taken in preparing a classified index for general distribution to all ASQC members.

A thorough knowledge of the *ASQC Literature Classification System* itself will aid in making the proper classification. The classifier should know the categories available.

It is helpful, but not essential, to memorize the code numbers of the most frequently used categories. In general, a zero in any code indicates a miscellaneous or general classification. This is especially true in the *Methodology or Technique Classification.*

An article should be classified in as fine a detail as possible; however, it should not be "forced" into a particular code. For example, an article on *control charts for ridits* is neither a *control chart for variables (111:)* nor a *control chart for attributes (112:).* Since no other code is available, the general code for *control charts (110:)* would be used.

The rules to follow are these:

a. If there is no specific code, use the nearest most general code.

b. If the article contains many subjects, use the nearest most general code *in addition to* the most important detailed codes. This procedure will simplify the addition of codes.

3. RECORDING—As you classify the articles, record the codes as a part of the article information on the inventory list. (You may also want to write the codes on the first page of the article.)

This minimum of effort will establish a classified quality control index. However, you may find that this basic listing of codes is difficult to use since one must scan the entire inventory listing in order to locate a specific code number.

You may wish to improve the efficiency of your classification by one of the following cross-indexing methods.

Method One—for small literature inventories.

One simple method for starting an index is to use a standard three-ring binder. Prepare four divider cards with the following captions:

Literature Inventory
Methodology or Techniques Codes
Functional Codes
Industry and Business Codes

The pages following the *Literature Inventory* divider should contain these minimum columns:

Article Number	Article Identification (Title, Author, Publisher, Publication Date, etc.)	Classification Code Numbers	File Location

Each of the three code sections should contain all of the code numbers in the classification system, together with the title of each code. This will make it unnecessary to refer to a separate code list.

Sufficient space must be allowed under each code number for recording the associated article numbers. Experience will dictate the proper spacing. It is recommended that no more than five codes per page be used initially.

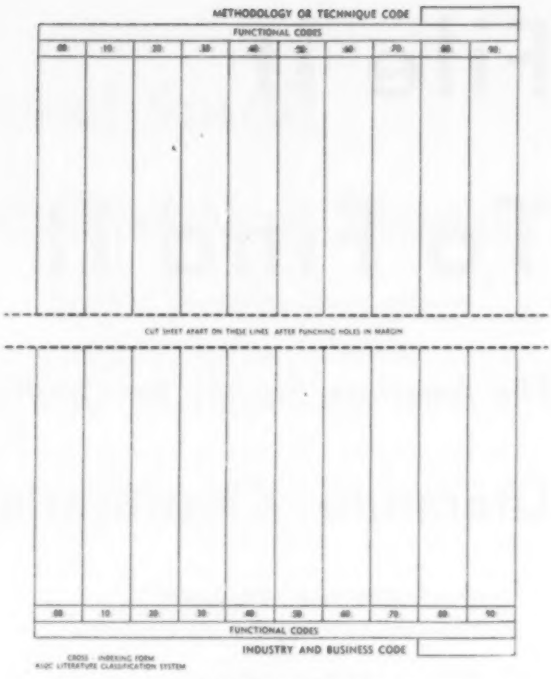
METHODOLOGY OR TECHNIQUE CODE
FUNCTIONAL CODES
00 10 20 30 40 50 60 70 80 90
CUT SHEET APART ON THESE LINES AFTER PUNCHING HOLES IN MARGIN
00 10 20 30 40 50 60 70 80 90
FUNCTIONAL CODES
INDUSTRY AND BUSINESS CODE
CROSS - INDEXING FORM
ASQC LITERATURE CLASSIFICATION SYSTEM

Fig. 1—Cross-Indexing Form

Example 1—Coding an Article

Suppose that inventory *article 1* was coded 111:70:437; *article 2,* 222:70:433; *article 3,* 111:60:433; *article 4,* 222:60:437; *article 5,* 11:60:435.

You would record the inventory numbers of the articles as follows:

Methodology or Technique Code	*Inventory Article Numbers*
111: Control Charts for Variables	1, 3, 5
222: Attributes Plans	2, 4
Functonal Code	
:60: Engineering	3, 4, 5
:70: Quality	1, 2
Industry and Business Code	
:433 Primary Metal Industries	2, 3
:437 Transportation Equipment	1, 4

Example 2—Locating an Article

To locate an article, for instance, on "control charts for variables—used in the engineering function—of the primary metal industry."

1. Note the article numbers under the code for *control charts for variables* (111:). These articles are numbers 1, 3 and 5.
2. Note which of the article numbers in (1) above appear under the code for engineering function (:60:). These article numbers are numbers 3 and 5.
3. Note which of the article numbers in (2) above appear under the code for *primary metal industries* (:433). This article is number 3—the article sought.

This example is obviously simplified since only five articles with one code each were used. However, a list of several hundred articles with two or three codes per

article would be difficult to scan for specific code numbers. For this reason the cross-reference by code is a time-saver.

Method Two—for very large literature inventories.

An alternative to the above arrangement is to use one 3 by 5 or 5 by 7 file card for each code number. This method eliminates the spacing problem, and is efficient for very large literature inventories.

Method Three—for average size literature inventories.

A third approach* is to prepare an 8½ by 11 master form† (as shown in Fig. 1, Pg. 6) with the *Methodology or Technique* Codes in the upper right-hand corner and the *Business and Industry* Codes in the lower right hand corner.

The body of the form is divided into 10 [—¾ inch wide] vertical columns with [½ inch for] a left hand margin. The columns are prenumbered both at the top and bottom with the ten codes—:00: to :90:—of the *Functional Classification*.

Approximately 120 copies of the form should be reproduced, punched in the margin for a multi-ring binder, and cut. The extra center space will allow individual half-sheets from each group to turn independently.

Record the *Methodology or Technique* and the *Industry and Business* codes—one on each page. Record in the columns of the upper set of forms the article numbers of the *Methodology or Technique* code indicated. In the columns of the lower set, record those article numbers with the appropriate *Industry and Business* codes.

The search for articles with a given code is thus simplified.

To find articles coded 111:60:433, for example, simply turn to the upper sheet marked 111:, and to the lower sheet marked :433. Those numbers in column :60: common to both sheets are the article numbers sought.

This cross-indexing method is mechanically most efficient. Search time is reduced and expansion of all excepting the *Functional* codes is facilitated.

A Look to the Future

One of the prime users of the *ASQC Literature Classification System* is the ASQC itself. Beginning with the July, 1959 (Vol. XVI) issue of *Industrial Quality Control*, all technical articles are being classified. The annual *IQC* Index to appear in the June, 1960 issue will contain an inventory of technical articles in chronological order, the cross-references by classification codes, and an author listing. The *IQC Five Year Index* (Vol. XI-XV) is currently being constructed in a similar manner.

Beginning July 1, 1959, all ASQC sponsored conferences, symposiums and conventions which publish proceedings will include the literature classification as a part of their proceedings. The literature classification will be in a form similar to the *IQC Index*. The *Table of Contents* will become the literature inventory with the addition of article numbers and classification codes.

Following the *Table of Contents* will be the cross-references by codes. In this case, unused codes may not be included.

An author listing will complete the literature classification.

It is anticipated that comments, questions, suggestions, etc., concerning the *ASQC Literature Classification System* will arise through the extensive use of the system. The ASQC Bibliography Committee is the "custodian" of the system. All communications should be addressed to the Chairman of the Committee in care of the ASQC Headquarters Office. Each communique will be considered and acted upon in the best interests of the Society.

The Bibliography Committee is beginning a project in which they will index and classify all ASQC controlled literature since 1944. It is expected that this project will result in the publication of a *Twenty Year Index* of all such literature, which would be an invaluable aid to the ASQC member. In addition, the Bibliography Committee is striving to work out methods of making specific articles referenced in the *Index* available to ASQC members.

The anticipated goal of the ASQC Bibliography Committee is to provide each ASQC member with the means of not only locating wanted quality control literature, but also of obtaining copies of this literature. The achievement of this goal would give the ASQC member the information he needs plus additional time to devote to more important activities.

*This method has been suggested by J. Y. McClure, Convair Division of General Dynamics Corporation, Fort Worth, Texas.
†This form may be reproduced without permission.

New Military Specification

The Department of Defense now has in force a new Military Specification, MIL-Q-9858, which supercedes MIL-G-14461 (ORD) and MIL-Q-9523C (USAF). This document is a Military Specification on Quality Control System Requirements for the "establishment of a quality control system by the contractor to assure that supplies or services meet the quality standards established by the contract." The new specification has been "approved by the Department of Defense and is mandatory for use by the Army, Navy, and Air Force."

Copies may be obtained from local Department of Defense procurement and inspection offices.

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Test Performance Charts

FRED ENNERSON, JR.

and

MARK MANNING

Hughes Aircraft Company,

Tucson, Arizona

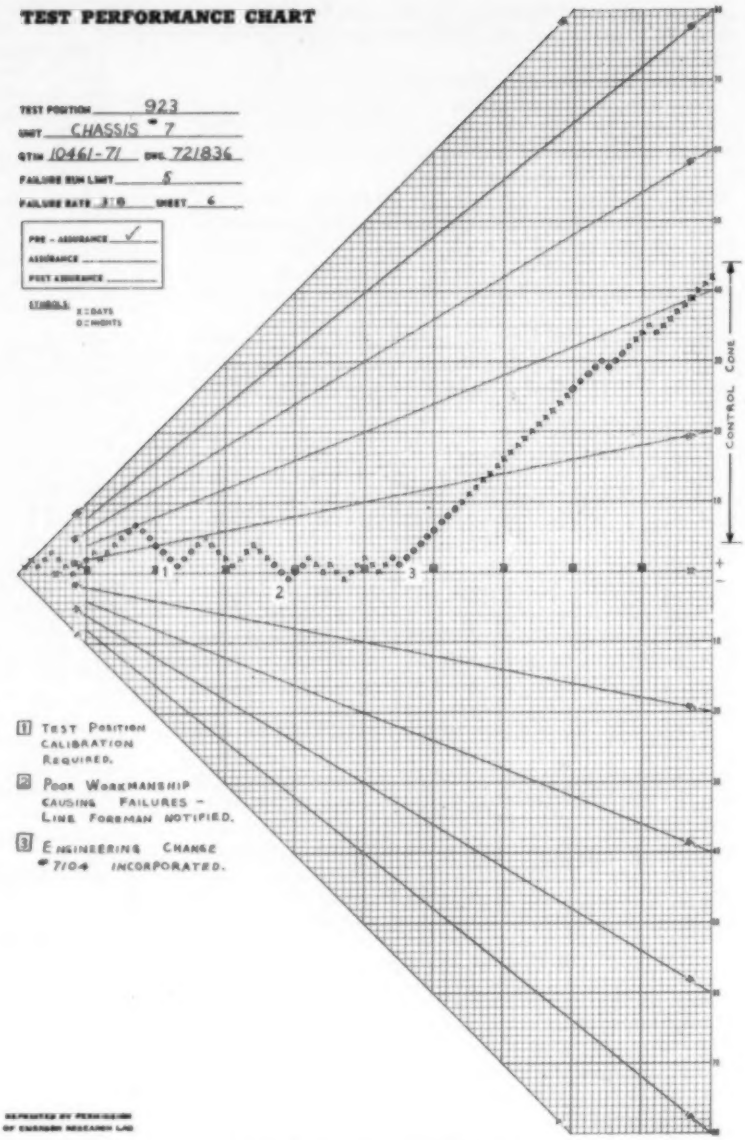

Figure 1—Test Performance Chart

A common method used for analyzing test results of complex units is to graph unit performance based on review of the test data. This can be done in two ways—analysis of individual test measurements, or monitoring quality levels on an attribute basis.

Any one test may involve a considerable number of test steps, each of which might be subject to detailed analysis. Regardless of benefits obtained in monitoring individual test measurements on the floor with testers plotting X and R-chart data, complex unit testing may involve dozens of charts for any one test position. To keep the program in operation, this would present a major problem in the piling up of paperwork. Hence, the "go, no-go" approach permits quality level floor controls without time-consuming clerical work.

The authors have devised a method whereby the individual tester can monitor quality levels without waiting for performance interpretation at a later time. This is handled on a single "Test Performance Chart" (see Fig. 1).

These test performance charts are a modification of those copywrited in 1955 by Emerson Research Laboratories. They are posted on each test position where they are clearly visible and easily plotted. The results of each test are noted immediately after the complete test cycle.

ASQC LCS Codes 710; 720:70:400

This chart is made up of a series of grids, as illustrated in Fig. 1. Testers plot only initial tests, which gives the true manufacturing quality level at all times. If the unit is completely acceptable, the tester marks an "X" on the diagonal "right-upwards". If a unit fails for any reason, the tester indicates a "right-downwards" plot on the diagonal. To provide supervision with information concerning differences between testers on the same position, or differences for two-shift operation, different symbols may be used to indicate unit acceptance or suspension.

Each chart is originally entered adjacent to the chart apex with an appropriate plot indicating test acceptance or suspension. Subsequent plots are entered until the entire plotting area is used up. The chart is basically designed for 100 tests.

The slanting guide lines indicate acceptance levels in terms of accumulative acceptance rates. As soon as the tester plots the most recently completed test result, he has before him, and to anyone else within the area, the exact accumulative test acceptance rate for the indicated number of units tested. Where sev-

eral test positions are used to test the same unit, these test performance charts are very effective in determining if acceptance rates are compatible among the test positions. Similarly, these charts readily show which units of various types are going to require additional engineering effort to improve the performance of any one unit.

At the completion of each test performance chart, the tester obtains a new chart, fills in all printed headings, and again enters test results beginning adjacent to the chart apex. After two such charts are completed, they are analyzed to determine what the authors choose to call a "control cone." These control cones, essentially 2-sigma control limits for "p" charts, are marked as indicated in Fig. 1. At the completion of the third and subsequent charts, if the last plot on each sheet falls below this control cone, the tester notifies his immediate supervisor promptly, and investigation is made to determine the cause of this falling off in process quality. It is, of course, just as important to find out why the process improved if the last plot per sheet falls above the control cone. As supplementary information, testers also indicate on the chart information concerning product acceptance changes, such as test position calibration, engineering changes, new manufacturing lot initiation, test position modification, etc. Subscripts are noted on the chart to indicate such changes, with brief remarks entered near the chart apex.

The test performance charts are also used to determine the effectiveness of an engineering change. For example, subscript #3 as shown in Fig. 1 indicates the incorporation of an engineering change. It is evident that product quality quickly improved. It is possible to calculate how many units are required to detect such an improvement and how many suspended items are allowed for this improvement in product quality.

Further statistical information is furnished to the tester, designated as a "failure run limit" and a "failure rate." The failure run limit is provided to permit the tester to know exactly when successive failures are indicating a significant deterioration of test quality.

Let us assume that we have a test position which has shown an average acceptance rate of 80 percent over 200 tests (2 sheets). The failure rate is thus 20 percent. This 20 percent failure rate is the same as 1:5. Therefore, the probability of finding a significant deterioration in test quality may be determined. At the observed failure rate of 1:5, the probability of testing two discrepant units successively would be:

$$(1/5)\ (1/5) = \frac{1}{25}$$

Obtaining three discrepant units successively would be:

$$(1/5)\ (1/5)\ (1/5) = \frac{1}{125}$$

The odds for noting three discrepant units are seen to be very small (1:125). The authors consider odds of 1:100 as significant for this type of operation. Consequently, with the example given, the failure run limit would be given as three (3). The failure rate would be given as 1:5.

This failure rate can be used to substantiate product quality deterioration. If the failure run limit is reached but there is no apparent cause or pattern of test failure, an additional number of tests may be made as prescribed by the failure rate to try to detect the cause. For the above example, five more tests could be run. If only one failure was observed, testing would be permitted to continue.

This concept of seemingly giving more leeway in terms of "take another look" is a conciliation between setting down hard and fast statistical ground rules and the problems of maintaining schedule and supervision's cooperation.

Once the control information is provided, regular reviews of subsequent sheets are maintained by the quality engineer with a view toward upgrading control cones and appropriate changes in failure run limits and rates if significant product quality improvement is noted.

Summary

The test performance charts require a minimum amount of the testers' time to maintain. These charts are always up to the minute, indicating the present quality level of the product going through a test position. The testers, through channels, are able to inform quality and engineering personnel when the failure run limit has been reached for a particular test position so that prompt action can be taken to prevent excessive failures. On the completion of each sheet, the tester is also able to inform cognizant personnel when there has been a significant change in the process average. No clerical or analytical work is required from the testers to maintain these charts.

For purposes of maintaining long range quality histories of a process, a "p" chart (not shown in Fig. 1) is attached to the lower left-hand corner of the test performance chart holding fixture. On this "p" chart, the accumulative test acceptance rate is plotted at the completion of each sheet. Control limits are provided to indicate the normal expected variability.

The success of this program was based upon the following:

(1) Simplicity of operation
(2) The desire of quality and engineering personnel to be part of this program.
(3) The placing of direct responsibility upon the tester to initiate corrective action for "on-the-spot" feedback of information to responsible departments

Some of the results obtained in this program are:

(1) Improvement of product reliability
(2) Reducing rework and scrap
(3) Promote operator and/or inspector interest on the job
(4) A guide for production supervision
(5) An effective tool for engineering

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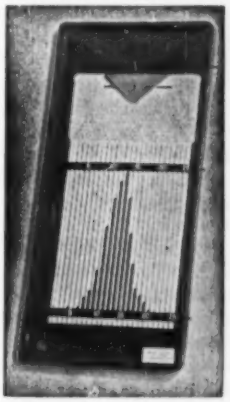

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Some Economic Considerations Of Inefficient Statistics

GAYLE W. McELRATH and JACOB E. BEARMAN

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INTRODUCTION

At times, we tend to analyze the data at hand by developing "efficient" statistical methods without regard to the question of economy. It is only practical to ask whether the time and effort put into the analysis and computation can balance the comparable value of the information measured in terms of dollars. Also, it is possible that the value of information, which is a result of the analysis of the data at hand, might decrease as the time lengthens between the collection of the data and its interpretation. As a result, some quick and inexpensive statistical methods could be very useful and economical when the conditions do not allow lengthy and more costly statistical analysis—even though the latter analysis may be more precise from the *theoretical* point of view. We will discuss several sample statistics which can be used to estimate the same population characteristics. In addition, we will discuss the concept of statistical efficiency as a criterion to choose the particular statistic which will be economically efficient to estimate the population value.

To those who have sufficient training in formal mathematics and statistics, the background material for an expository article of this nature is "readily available" in statistical literature. Thus the authors do *not* pretend that the statistical concepts of this article are "new." That which is new, however, is the method of presenting the material in the framework of reference of the quality control engineer or other statistical practitioners in order that they might take advantage of the findings in statistical literature and apply them profitably. Certainly, one of the objectives of such a paper is to stimulate the reader to think about the possibilities and to discover—by trying a few of them—that they really work! Indeed, if the reader is interested, the authors have given a generous bibliography of basic papers in statistical theory which may serve as source material for the following.

ASQC LCS Codes 400; 550:60:000

*Presented at the Administrative Applications Division Conference, American Society for Quality Control, Cleveland, Ohio, February 7-8, 1958.

Measures of "Central" Value

When we are asked to estimate the mean value, $\bar{X}'$, of a population, we very often think only of calculating the sample mean value, $\bar{X}$; that is, the arithmetic mean. We may forget that there are many other statistics which can be used to estimate the same population value or parameter. The question then becomes which estimate should be used? Consider the following measures of central value *other* than the arithmetic mean which may be used as the "average."

The MEDIAN is the *middle value*, if there is one, when the observations of the sample are *numerically ordered*. If there is an odd number of observations in the sample, there is a middle value. If there is an even number of observations, there is no middle value; in this case, the median is usually taken as the arithmetic average of the *two* numbers which are in the middle. The median of the following set of numbers: 43, 46, 50, 51 is the average of 46 and 50, or 48.

We will denote the median by P_{50}; this might be called the 50^{th} percentile of the sample. There are as many observations above the median of a sample as there are below. However, we must interpret "above" to have the meaning "greater than or equal to," and "below," to have the meaning "less than or equal to." There may be several observations of the sample equal to the median. For example, the median of the observations

5, 9, 66, 66, 66, 66, 66, 66, 90

is the middle value, 66. This example illustrates a characteristic of the median, namely, that its value is not affected by how extreme the extreme values are. The value of the median in the above set of observations would not change if the extreme value happened to be 9000 rather than 90. This characteristic is true of the commonly used percentiles determined from a reasonably large set of observations. The sample MODE is the value of the observation which occurs most frequently. The sample MIDRANGE is the arithmetic mean of the largest and smallest observation. A sample PERCENTILE ESTIMATOR, for example, $(P_{25} + P_{75})/2$ can be used as an estimator of central value.

All of the above sample values describe the data as to general location on the scale of values, or "center" of the data. At this point the only guides to determine which estimator to use are intuition and a desire for simplicity.

Measures of Variability

In a similar manner, when we are asked to estimate the standard deviation, σ', of a population we very often think of calculating the standard deviation, σ, of the sample. However, there exist several statistics which can be used to estimate the population standard deviation, and again we are confronted with the decision as to which estimation shall be used. Some commonly used descriptive statistics to measure variability are the sample standard deviation, sample variance, sample range, sample mean deviation, sample semi-interquartile range $(P_{75} - P_{25})/2$, sample percentile estimator 0.3388 $(P_{93} - P_{07})$, etc., etc.

It is assumed that the reader is familiar with both the standard deviation and the range. The VARIANCE is defined as the square of the standard deviation. The MEAN DEVIATION is defined as the average of the absolute values of the deviations from the sample median; that is

$$\frac{1}{n} \Sigma \mid X_i - P_{50} \mid$$

Two Reasonable Criteria to Require of a Statistic

If a statistic tends to be a little *less* or a little *greater*, on the average,

than the parameter being estimated, the statistic is said to be a "biased" estimator. The sample variance

$$\sigma^2 = \frac{\Sigma(X_i - \bar{X})^2}{n}$$

tends to be a little *less* than σ'^2, *on the average;* it is a biased estimator of σ'^2. The description "biased" sounds somewhat improper; to the extent that we may wish to avoid this bias, the above sample variance may be "corrected" by multiplying the above quantity by $\frac{n}{n-1}$; that is

$$\frac{n}{n-1}\,\sigma^2 = \frac{\Sigma(X_i - \bar{X})^2}{n-1}$$

This estimation of the variance then, gives the "right" answer on the average and is said to be an *unbiased* estimator of the population variance σ'^2. The property of being unbiased is pleasant but is of questionable virtue all by itself. However, for the purpose of this article, we will limit ourselves to a discussion of unbiased statistics.

A second, and more important, property of a statistic is that it gives values which, most of the time, are close to the population value being estimated. In other words, we desire that the sampling distribution of the statistic be concentrated closely about the right value. That statistic (if there is one) which gives values that are more closely concentrated about the population value than any other statistics is said to be the EFFICIENT statistic.

In this article we define the relative efficiency E of other unbiased statistics to be the ratio of the variance of the sampling distribution of the efficient statistic to the variance of the sampling distribution of the statistic being compared.

The Case of the Normal Distribution

In many quality control applications we continually assume that the characteristic of interest is normally distributed. We often wish to estimate the population mean. Why have we "always" used the sample mean, $\bar{X}$, to estimate the population mean, $\bar{X}'$? The popularity of $\bar{X}$ is no accident. The sample mean, $\bar{X}$, from a normal population is an unbiased estimator of the population mean, as are the arithmetic means of all random samples; and, in addition, what is more important, the sample mean is the efficient estimator of $\bar{X}'$. This tells us that the variance of the sampling distribution of $\bar{X}$ from a normal population, which we recall is σ'^2/n, is smaller than the variance of the sampling distribution of any other estimator of $\bar{X}'$ that anyone can dream up. If the population is normal, the relative efficiency of the median for large sample sizes is

$$\frac{\text{Var of } \bar{X}}{\text{Var of } P_{50}} = 0.64$$

If we measure precision by the variances of the sampling distributions, it can be shown that the efficiencies are approximately equal to the ratio of the sample sizes which give equal precision to the estimators. In particular, then, if we take 1000 random observations and determined the sample median, we obtain the same precision as if we had determined the sample mean based on 640 random observations. This information might be of non-trivial economic value.

For example, suppose that the experimental design calls for a random sample of 640 observations in order to obtain the required precision to estimate the population mean in terms of the sample mean, $\bar{X}$. Suppose further that each one of the 640 determinations requires one hour's work to obtain it. Imagine that a qualitative operation can quickly order the magnitudes of the 640 specimens. Perhaps this can be accomplished with as little as ten hours work. Certainly, it would then be worth approximately twenty hours to take an additional 361 specimens; order the 1001 specimens; take the 501st specimen; and perform a single complete determination on it.

The point is, that the estimator of the population mean from this 20 hours worth of laboratory work—using the median as an estimator—is at least as reliable an estimator as the sample mean based on the number that cost 640 hours of laboratory work. Of course, we should realize that the additional materials for 361 specimens *might* cost more than the saving of the 620 hours. However, the point is: in order to make a proper decision with economic advantage, the alternatives must be investigated carefully.

Other Interesting Distributions

Warning! Do not get the misconception that the sample mean is always the efficient statistic for estimating a population mean of every distribution. For example, suppose that we happen to be concerned with estimating the mean of a uniform distribution. The probability function of the uniform distribution has the form.

$$\text{Probability function} = \frac{1}{b-a}$$

for the values of the random variable X between a and b and is equal to zero otherwise. In this situation the sample mean should *not* be the favorite estimator of the population mean. The midrange (to which you have been introduced previously) is unbiased and is the efficient estimator.

Consider another situation which proves to be quite academic in interest but informative. The sample is not taken from a normal population but is taken from a process which might better be represented by a so-called Cauchy distribution. The probability function of the Cauchy distribution has the form

$$\text{Probability function} = \frac{1}{\pi}\,\frac{1}{1+(x-m)^2}$$

for values of the random variable X on the real line. The graph of this function appears deceptively "normal." However, it is remarkably different from normal in its properties. The Cauchy distribution is perhaps not so important for its practical applications as it is for its use as an example of a distribution which has the peculiar characteristics of having *no mean* (in the usual sense) and no variance (at all!) to be estimated by sample measurements. It seems intuitively reasonable that the sample mean $\bar{X}$ would have to be replaced by another statistic to estimate the "central" location of the Cauchy distribution.

Investigation of Large Samples

Percentile Estimators of the Mean

The following remarks concern the treatment of large samples, say 100 or more drawn from populations assumed to be normal. Indeed, the samples may have several hundreds of observations.

In a previous section of this article, we discussed the relative efficiency of the sample median, P_{50}, for large samples. We can increase the relative efficiency of our percentile estimator of the mean by considering the mean of combinations of two, three, or more sample percentiles. We are interested in the mean of that combination of a given number of percentiles whose sampling distribution has the smallest

dispersion. In this manner we optimize the precision for a given expenditure. Table I gives the optimal combinations of sample percentiles (and their relative efficiencies) which may be used to estimate the mean of a normal distribution.

Percentile Estimators of the Standard Deviation

In order to estimate the standard deviation of a normal distribution, it is necessary to take the *differences* of groups of sample percentiles and multiply them by an appropriate constant. For example, if we use only two sample percentiles to estimate the standard deviation, the estimator $0.3388(P_{93} - P_{07})$ has the highest relative efficiency, namely, 0.65. The coefficient 0.3388 is obtained from the normal distribution as follows. The P_{93} and P_{07} for a normal distribution are 2.952 standard deviations apart. That is,

$$P_{93} - P_{07} = 2.952\,\sigma'$$

Since 1/2.952 equals 0.3388 we multiply the difference of the sample percentiles to obtain the estimator of the population standard deviation. It is found that a combination of three percentiles used to estimate the population's dispersion increases the relative efficiency only slightly. However, the combination of four sample percentiles which have the highest relative efficiency is 0.1714 $(P_{97} + P_{85} - P_{15} - P_{03})$ with a relative efficiency of 0.80. The coefficient 0.1714 is obtained in a manner similar to that described above, but appropriate for the percentiles used. The relative efficiencies of the sample percentile estimators of the standard deviation are obtained by comparing the variance of the sampling distribution of the percentile estimator to that of the variance of the sampling distribution of the sample variance. Table II gives the relative efficiencies for additional sample percentile estimators of the standard deviation.

Sample Percentiles for Joint Estimation of the Mean and Standard Deviation

We can observe from Table I and Table II that the combinations of percentiles used to estimate the population mean are grouped nearer to the center of the distribution while the percentiles used to estimate the standard deviation are scattered further out in the distribution. When we become interested in combining sample percentiles to be used for joint etstimation of both the mean and the standard deviation, we must compromise some efficiency in each, and suggest the combination of percentiles which give relatively high efficiency for both the mean and standard deviation jointly. Table III gives the sample percentiles for joint estimation of the mean and standard deviation, along with the efficiency of the estimators.

Some Economic Considerations of the Sample Percentile Estimators

We might feel that, having collected a large number of observations, it hardly pays to throw away most of them. But there are situations where it is easy to place the observations in approximate order of size and quite difficult to *measure* any single observation; the amount of precipitate in a number of test tubes is one example from among many available. In such situations it is economically feasible to use the sample percentile estimators. Most of the difficult analytical work is thus omitted, with a surprising efficiency in the results.

Another point that must be emphasized is that the sample percentile estimators may mean a remarkable speed-up in output of data. The economic aspects of such speed-up can, on occasion, be crucial. The loss of small amounts of precision can be superseded many-fold by a decreased time interval between the collection of data and its being whipped into usable form; it can mean the difference between valuable data available for important economic decisions and very precise, but only interesting, facts with little practical worth.

Investigation of Small Samples

Estimators of Central Value

In an analogous manner, there are desirable inefficient statistics to be used for small samples, say, ten or less observations drawn from populations assumed to be normal. Again one of our motivations is to obtain statistics with quite high statistical efficiency that can give information concerning the population and at the same time be economically efficient. We will assume that the observations have been taken from a normal population and that they have been arranged in order of size.

Table IV gives the relative effi-

TABLE I—Sample Percentile Estimators of the Mean[1]

	Percentile Estimator	*Efficiency*
1	P_{50}	0.64
2	$0.5(P_{25} + P_{75})$	0.81
3	$0.3333(P_{17} + P_{50} + P_{83})$	0.88
4	$0.25(P_{12.5} + P_{37.5} + P_{62.5} + P_{87.5})$	0.91
5	$0.20(P_{10} + P_{30} + P_{50} + P_{70} + P_{90})$	0.93
..	...	...
10	$0.10(P_{05} + P_{15} + P_{25} + P_{35} + P_{45} + P_{55} + P_{65} + P_{75} + P_{85} + P_{95})$	0.97

TABLE II—Percentile Estimators of the Standard Deviation[2]

	Percentile Estimator	*Efficiency*
2	$0.3388(P_{93} - P_{07})$	0.65
4	$0.1714(P_{97} + P_{85} - P_{15} - P_{03})$	0.80
6	$0.1180(P_{98} + P_{81} + P_{90} - P_{20} - P_{19} - P_{02})$	0.87
8	$0.0935(P_{98} + P_{88} + P_{68} + P_{77} - P_{23} - P_{14} - P_{07} - P_{02})$	0.90
10	$0.0739(P_{98.5} + P_{88} + P_{80} + P_{54} + P_{23} - P_{20} - P_{18} - P_{10} - P_{05} - P_{01.5})$	0.92

TABLE III—Percentiles for Joint Estimation of the Mean and Standard Deviation[2]

	Percentile	*Efficiency*		*K Multiplier for the Estimate of* σ'
		Mean	*Std. Deviation*	
2	15, 85	0.73	0.56	0.4824
4	05, 30, 70, 95	0.80	0.74	0.2305
6	05, 15, 40, 60, 85, 95	0.89	0.80	0.1704
8	03, 10, 25, 45, 55, 75, 90, 97	0.90	0.86	0.1262
10	03, 10, 20, 30, 50, 50, 70, 80, 90, 97	0.94	0.87	0.1104

TABLE IV—Efficiency of Sample Median

Sample size	2	3	4	5	6	7	8	9	10	∞
Efficiency	1.00	0.74	0.84	0.70	0.78	0.68	0.74	0.67	0.72	0.64

TABLE V—Efficiency of Sample Midrange

Sample size	2	3	4	5	6	7	8	9	10	∞
Efficiency	1.00	0.92	0.84	0.77	0.71	0.65	0.61	0.57	0.54	0

TABLE VI—Efficiency of the Statistic Formed by Averaging the Third Term from each End of the Sample

Sample size	*Estimator*	*Efficiency*
6	$(X_3 + X_4)/2$	0.78
7	$(X_3 + X_5)/2$	0.82
8	$(X_3 + X_6)/2$	0.84
9	$(X_3 + X_7)/2$	0.84
10	$(X_3 + X_8)/2$	0.84

TABLE VII—Efficiency of the Estimator of the Standard Deviation Obtained from the Sample Range

Sample size	*Estimators*	*Efficiency*
2	$0.886(X_2 - X_1)$	1.00
3	$0.591(X_3 - X_1)$	0.99
4	$0.486(X_4 - X_1)$	0.98
5	$0.430(X_5 - X_1)$	0.96
6	$0.395(X_6 - X_1)$	0.93
7	$0.370(X_7 - X_1)$	0.91
8	$0.351(X_8 - X_1)$	0.89
9	$0.337(X_9 - X_1)$	0.87
10	$0.325(X_{10} - X_1)$	0.85
.	.	.
.	.	.
.	.	.
∞		0.00

ciencies for the median of small samples as estimator of the population mean of a normal distribution. Here the approximate relative efficiencies have been obtained by comparison with the sample arithmetic mean, the efficient estimator. It is interesting to note that the efficiency of the median is higher for the even sample sizes than for the odd. It sounds reasonable that the averaging of the two middle terms, when determining the median of an *even number* of observations, should make the median a more efficient estimator than it is for samples with "near by" odd number of observations. As the sample size increases, the efficiency of the median approaches 0.64, the relative efficiency for the median of large samples.

Table V gives the relative efficiencies of the sample midrange as an estimator of the population mean of a normal distribution. Here we have a chance to compare the relative efficiencies of the midrange and the median. The midrange has higher relative efficiency for smaller samples but tapers off more rapidly as the sample size increases beyond 5 and approaches *zero* for large samples and *not* 0.64.

It is interesting to note that the relative efficiency can be improved by averaging the third observations from each end. Table VI indicates the efficiencies of this statistic as an estimator of the population mean value.

Estimators of the Standard Deviation

The quality control engineer has long used the range to estimate the standard deviation for a small number of observations. Unlike the previous percentile estimators of the standard deviation for large samples, the range is a biased and inefficient estimator of the standard deviation. However, when we multiply the range by the appropriate correction factor, we obtain unbiased estimators of the standard deviation. Table VII gives the respective relative efficiencies for the sample range.

It is interesting to note that we are already acquainted with the above coefficients but in a different guise. That is the coefficients given in Table VII for the range are just $1/d_2$. For example, if the sample has five observations, d_2 equals 2.326 and $1/2.326$ is approximately equal to 0.430—the coefficient attached to the range given in Table VII. With the information given in Table VII, one can readily see that in many applications the range is certainly economically efficient; hence its use in industrial applications is justified from this point of view as well as from the aspect in which it is usually presented.

We have previously defined the mean deviation. This estimator of the standard deviation must also be multiplied by an appropriate factor to yield an unbiased estimator of the standard deviation. The operation of dividing by the sample size to obtain the mean deviation has been included in this coefficient. Table VIII gives the relative efficiencies of the sample mean deviation for different sample sizes.

In the development of the statistical theory of estimation, there has evolved what is called the "best linear unbiased" estimator of a population parameter. To estimate the standard deviation by the best linear unbiased estimator is to do almost as much work as to calculate the sample standard deviation itself. However, if we continue to assume that the observations have been drawn from a normal population, then we can discuss a "modified linear estimator" of the standard deviation. This modified estimator is easier to compute than the mean deviation, and has relative efficiency greater than or equal to the relative efficiency of either the range or the mean deviation for samples of size 5 through 10. Table IX gives the form of the modified linear estimators together with their relative efficiencies.

Summary

In this article the authors have been concerned about the economics that can be involved when choosing an estimator. In order to have a disciplined approach, we had to set up some "ground rules" for evaluating the "goodness" of a sample statistic. We defined such terms as "unbiased" and "efficient" statistics and in an engineering spirit also extended our thinking to the concept of the "relative efficiency" as an unbiased estimator. In a very natural manner, we thought of the precision of an estimator to be

TABLE VIII—Mean Deviation Estimator of the Standard Deviation[3]

Sample Size	*Estimator*	*Efficiency*
2	$0.8862(X_2 - X_1)$	1.00
3	$0.5908(X_3 - X_1)$	0.99
4	$0.3770(X_4 + X_3 - X_2 - X_1)$	0.91
5	$0.3016(X_5 + X_4 - X_2 - X_1)$	0.94
6	$0.2369(X_6 + X_5 + X_4 - X_3 - X_2 - X_1)$	0.90
7	$0.2031(X_7 + X_6 + X_5 - X_3 - X_2 - X_1)$	0.92
8	$0.1723(X_8 + X_7 + X_6 + X_5 - X_4 - X_3 - X_2 - X_1)$	0.90
9	$0.1532(X_9 + X_8 + X_7 + X_6 - X_4 - X_3 - X_2 - X_1)$	0.91
10	$0.1353(X_{10} + X_9 + X_8 + X_7 + X_6 - X_5 - X_4 - X_3 - X_2 - X_1)$	0.89

TABLE IX—Modified Linear Estimator of the Standard Deviation[3]

Sample Size	*Estimator*	*Efficiency*
2	$0.8862(X_2 - X_1)$	1.000
3	$0.5908(X_3 - X_1)$	0.992
4	$0.4857(X_4 - X_1)$	0.975
5	$0.4299(X_5 - X_1)$	0.955
6	$0.2619(X_6 + X_5 - X_2 - X_1)$	0.957
7	$0.2370(X_7 + X_6 - X_2 - X_1)$	0.967
8	$0.2197(X_8 + X_7 - X_2 - X_1)$	0.970
9	$0.2068(X_9 + X_8 - X_2 - X_1)$	0.968
10	$0.1968(X_{10} + X_9 - X_2 - X_1)$	0.964
11	$0.1608(X_{11} + X_{10} + X_9 - X_4 - X_2 - X_1)$	0.967
12	$0.1524(X_{12} + X_{11} + X_9 - X_4 - X_2 - X_1)$	0.972

measured by the variance of its sampling distribution. A most significant property, economics-wise, is the property that the efficiencies of the statistics are approximately equal to the ratio of the sample sizes which give equal precision to the estimators. By the use of this property, we can balance the question of *sample size* needed against the desired precision, considering the economics of the overall situation. To this end, we can more intelligently choose the estimator by using the criteria of relative efficiency balanced against desired precision. That is, use of these principles lets us balance cost against desired precision.

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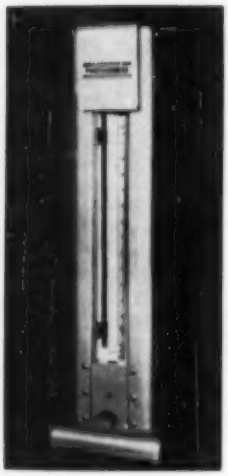
What's New?

ROY A. WYLIE, *Editor*

Ampex Corporation



P-9-2—A column-type Precisionaire dimensional inspection air gage with fifteen inches of gaging range has just been annonunced by The Sheffield Corporation. Designated the Model 1500 series long-range Precisionaire instrument, the new gage has a full fifteen inch linear column and scale with amplifications up to 100,000 to 1. Single column instruments with standard amplification of 5000 to 1, or 10,000 to 1, are available for immediate delivery. A super-amplification kit for use with the 10,000 to 1 instrument provides amplifications of 20,000 to 1, 40M, 50M, 80M, and 100,000 to 1 without changing the glass column. The "Super-Amp" Model consists of a single column instrument, Pneumatic Amplifier, and one each of the complete range of scales. The kit is also available for immediate delivery. At 5000 to 1 amplification, the long-range Precisionaire has an inspection range of .003 inches with scale graduations in 50 millionths, and at 100,000 to 1 amplification, range is .00015 inches with 2 millionths graduations. The longer gaging range also permits a large number of part sizes to be classified within a given tolerance range. For example, 45 size classifications of .0001 inch each with ¼ inch spread between each size require only 11¼ inches of the 15 inch linear column. Standard Precisionaire gaging elements such as spindles, snaps, Plunjet gaging cartridges, and open-jet tooling which are balanced for part tolerance can be used with the longer range instrument. Existing Precisionaire tooling can also be used on the instrument within the original tolerance spread of the gaging element. Or, the tooling can be reprocessed for the wider range of linearity. The long-range Precisionaire doubles the amplification of Plunjet cartridges. It also enables air gage tooling with standard small size jets to achieve full amplification.

★ ★ ★

P-9-4—A new type of internal comparator has been introduced by the Mahr Gage Company. Under the trade name "Intramess", the new gage has a spring loaded bridge, the cradle shaped ends of which form an equal sided triangle with a sensitive measuring contact of the instrument. By means of this bridge, the instrument is automatically centered in the bore and permits measurements accurate to 50 millionths of an inch for checking of size, out-of-roundness, bellmouth, taper and other irregular condition, at any diameter and any depth within range of the instrument. The amplifying unit employed is the sensitive "Millimess" Comparator Gaging Head with shockproof movement, fully jewelled and a total range of ± .002 inches. To determine the correct diameter of the bore, the instrument is rocked along the axis in a pendulum-like manner, whereby the contact points traverse a line at a right angle to the axis. The maximum reading of the indicator hand during this motion corresponds to the true diameter of the bore. For the checking of small bores, spring-loaded split jaw measuring heads are supplied and these can be screwed into the instrument. The gages cover a range from .060 inches to 10.000 inches. Extensions for increasing of bore depth are furnished to special order.

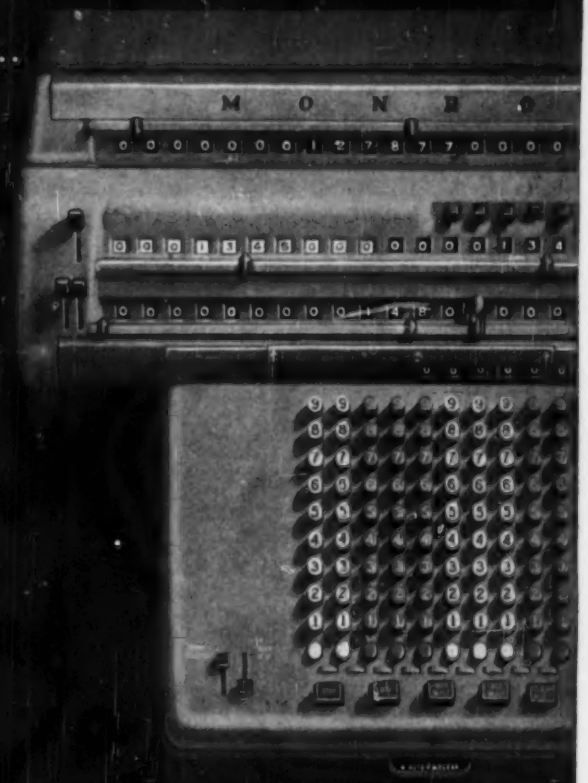
★ ★ ★

P-9-6—An improperly adjusted centerless grinder can produce work that is deceptively out-of-round. Conventional two-point measuring tools, which check diameter only, will pass the work. The No. 483 V-Anvil Micrometer has three-point contact which quickly detects out-of-round, alerts the operator to the need for machine adjustment and saves making scrap. The No. 483 is also designed for measuring three-fluted cutting tools—taps, milling cutters, reamers, etc. A companion micrometer No. 485, measures five-fluted cutters. These V-Anvil micrometers are used as conventional outside micrometers and the reading is taken directly in thousandths from the micrometer thimble. Precision features of these micrometers include V-anvils and spindle precision aligned to form perfect tangential contact, finely lapped carbide facings to eliminate wear from continuous use under abrasive conditions, hardened and ground from the solid spindle screw, no-glare chrome finish for easy reading in any light and balanced design for easy, one-hand measuring.

For the sophisticate in figures...

a Monroe that will do everything other Calculators do,

plus:



1. **Automatic Decimals**: you set all numbers . . . add, multiply, subtract or divide automatically around a single decimal point.

2. **Multi-factor Multiplication**: return the transfer slide and the last product becomes the next multiplier.

3. **"Memory Dials" Accumulation**: products are accumulated automatically in the "Memory Dials" while the results of individual problems appear in another dial. Quotients can be accumulated in one dial while individual quotients appear in another.

4. **Selective Division**: you can divide directly into the "Memory Dials" for super-fast averages or the determination of Standard Deviation.

5. **Automatic Carriage Positioning**: following a multiplication, the carriage automatically positions itself, decimally correct for addition or subtraction.

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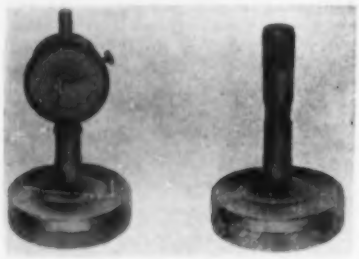
Monroe Calculating Machine Company, Inc. Sales and service in principal cities everywhere. General offices, Orange, N. J.

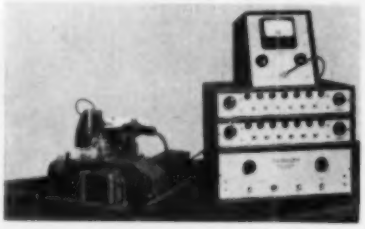
P-9-3—Two new types of leveling squares of Swiss Precision Make are being offered by Opto-Metric Tools, Inc. The solid square which is recommended for checking squareness between machine members, is available in three degrees of sensitivity: 3, 5, and 10 seconds of arc, to meet any reasonable requirement. On account of its extreme accuracy, the range is limited to that of the bubble tube, ± 7 intervals. The other square, which is really a simplified and inexpensive Clinometer, has a range of 0-180-0 degrees with vernier reading in 6 minutes of arc. The inherent accuracy is 30 seconds of arc.

★ ★ ★



P-9-13—To meet increased chamfer gaging requirements, a chamfer gage with a major diameter capacity of 2 inches to 3 inches has been added to the standard gages manufactured by Acme Scientific Company. The 2 to 3 inch model will be available in two styles: To measure included angles from 0 degrees to 90 degrees and 90 degrees to 127 degrees. Where precise measurements are to be made, such as in machine set ups to control the depth of the chamfer, the standard Chamfer Micrometer gage is easy to use and accurate. In cases such as receiving inspection, where quantities of chamfer holes must be inspected quickly, a Chamfer Indicator is available with a full range direct reading dial indicator. All Acme Chamfer Gages are furnished in a felt lined protective box and include a master setting gage. A 2 to 3 inch capacity 0 degree to 90 degree included angle Chamfer Micrometer is priced at $263.00.

★ ★ ★



P-9-7—The AIL High Speed Automatic Dice Sorter is a complete equipment system that automatically measures and sorts small delicate parts on the basis of thickness. A rotary vibratory feeder with its feed track designed to handle the light weight, fragile germanium or silicon dice, is used for pre-gage storage and initial delivery. From this hopper the dice are automatically transported, positioned, gaged, classified, and physically sorted into one of 13 grades of thickness. This High Speed Automatic Dice Sorter is particularly adaptable to germanium dice because of their small size and fragile nature. In operation, the dice are fed out of a rotary vibratory feeder. During their travel along the feeder, the dice are positioned in single file; doubles are removed automatically and returned to the input. At the end of the feeder the dice pass a set of vacuum holes, the leading die interrupts a photo-electric circuit as it moves onto the gaging anvil. Interruption of the photo-electric circuit is used to energize a vacuum hold circuit which prevents all other dice on the feeder from moving across the photo cell opening and initiates a complete gaging cycle for the particular die on the anvil. The die is then positioned on a gaging anvil where its thickness and grade classification is obtained using the MICROtrol Gage Head, Comparator Unit, and Classifiers. This combination of standard units reliably gages to .00005 inch and classifies into grades of .000025 inch increments. After the die has been electronically classified, the information is transmitted from a control unit to a 13 grade rotary segregator which homes to the corresponding grade position and presents the proper segregation vial. The die is gently transported into this prepositioned vial and the system then resets for the next die. The machine handles almost 3600 dice or wafers per hour. The parts to be gaged can range in size from .040 inches × .040 inches × .0015 inches to .190 inches × .190 inches by .010 inches.

★ ★ ★

P-9-5—Designed for on-the-line testing of high volume production items, the new Hyge-6500 compact shock tester repeats either of a choice of two widely specified shock pulses in rapid succession. It can perform a complete test cycle every minute. External adjustment permits change-over of the Hyge-6500 in just a minute or two. Unit cost is kept low by limiting capability to the two shock test specifications most frequently encountered in volume production: MIL-E 5272A (11± 1 ms Half-sine), and Ramo-Woolridge (6± .5 ms Sawtooth). Use of compressed bottled nitrogen as the power source keeps operating cost down to an average of 5 cents per test. The Hyge-6500 tests specimens ranging in weight from a fraction of an ounce up to 150 pounds. Internal deceleration eliminates the need for rail systems so that wide, bulky specimens can be easily accommodated on the specimen carriage. The carriage is 12½ inches in diameter and 2 inches thick, with a natural frequency of 2000 cycles. Fixture mounting holes are standardized with those used in shaker testing. Acceleration level for the Half-sine test is from 10G to 100G. For the Sawtooth test the level is 25G to 100G. Like change of waveform, acceleration level can be varied by a fast, simple external adjustment. Maximum specimen thrust is 15,000 pounds. Elimination of external braking devices such as rail systems make this Hyge-6500 compact enough to

DEMONSTRATE AND TEACH THE USE OF STATISTICS . . .

. . . to your plant personnel or statistics students in an interesting, effective manner with the PROCESS SIMULATOR—an electrical analog of an industrial process. Select the desired functional relationships and process standard deviation to simulate your own industrial process. Observe the results of statistical applications in a valid, impressive demonstration. The correct solution to each statistical problem, or the true parameters of the simulated process, can be dramatically shown by switching off the automatically created process variance. A very effective teaching and demonstration aid for applied statistics, operations research, quality control and other related fields. Write for details.

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MACHINE TOOLS can be TAUGHT

. . . to produce closer tolerances, Faster and Automatically . . .

. . . by use of *MICROtrol** gaging and control elements, selected combinations of these *MICROtrol* 160 elements permit you to control production automatically. They will inspect each piece, sort out the rejects, and tell the operator and/or machine tool *when* and *how much* correction is needed. Simple and flexible, 54 *MICROtrol* elements can automate all of your production immediately . . . or by stages.

MICROtrol electronic inspection and controls make needed corrections before rejects pile up . . . without stopping the machine tool to check work. *MICROtrol* takes pressure off the operator . . . allows him to produce more . . . with greater accuracy.

Centerless grinding tolerances up to .000025 are possible by adding an INCHWORM motor to the *MICROtrol* 160 system. When used in a closed loop system, *MICROtrol* elements automatically gage work, feed back correcting information to the INCHWORM, compensate for wheel wear . . . instantaneously.

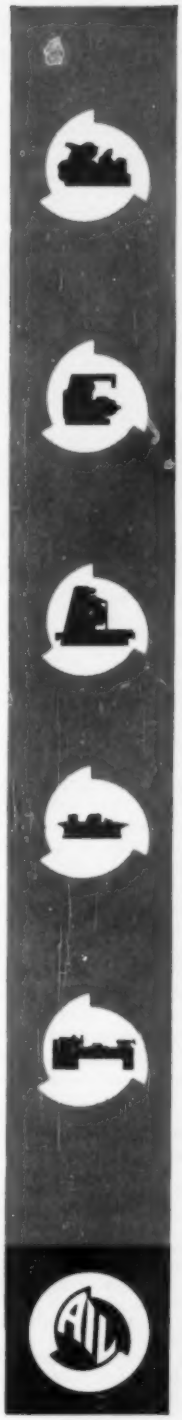
SEE IT WORK IN YOUR PLANT . . .

at Our Expense!

The INCHWORM can be installed on your centerless grinder in less than an hour—and proves itself immediately. We will install it in your plant, *on approval*, upon the recommendation of our sales engineer.

Contact your nearest Cutler-Hammer office or write AIL for full details, and descriptive literature.

*Trade Mark



AIRBORNE INSTRUMENTS LABORATORY

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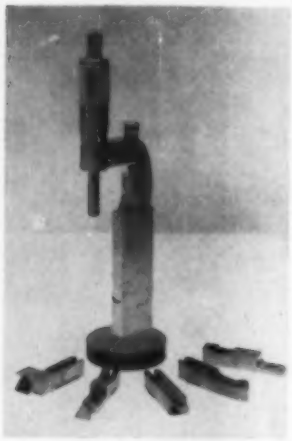
A DIVISION OF CUTLER-HAMMER, INC.

be built right into production lines. Base is only 13 inches square, the height is not quite 30 inches. Simplicity of operation permits use of inexperienced people. Operating safety is assured by automatic pressure bleed-off after firing and by manual operation of toggle valve to rebuild pressure for the next shot.

★ ★ ★



P-9-15—The exclusive Polyplan universal 0-1" and 0-4" micrometers, accurate to 1/10,000 of an inch, speed and facilitate production with their 6 interchangeable, rotating anvils. The anvils are easily interchanged, and can be swung a full 360 degrees, thus permitting easy and rapid measurements whose points of reference are on different axes. The 0-4" micrometer, with its all-purpose application anvils, can replace many conventional micrometer sets of various sizes and, because of the easy maneuverability of the anvils, the distinct advantage in terms of labor and production can be readily appreciated. This 0-4" micrometer is an ingeniously convertible one that can handily serve as 0-1", 0-2" and 0-3" instruments as well. The change-over is accomplished by the simple expedient of adding 1, 2 or 3 inserts, each measuring 1 square inch, to an 0-1" micrometer designed for extremely easy conversion. A baseplate anvil converts the instrument into a sturdy table model, which can also serve as a miniature height gage.

P-8-1—Automatic corrosion measurements are now possible using the Crest Model L-2 Corrosometer. The new Corrosometer is capable of detecting as little as one millionth on a routine basis and one billionth of an inch in some special applications. It automatically "tracks" corrosion as it occurs, providing a permanent record of the total thickness of metal corroded. This record is presented as a function of time which is quickly converted to the rate of attack. The meter greatly simplifies the job of evaluating the effects of corrosion inhibitors on the resistance of various metals to known corrosive conditions. A single Model L-2 may be used to monitor up to twelve individual tests by adding additional measuring units. A single multipoint recorder can be used to record data from these tests being run in parallel at the same time. The Crest Model L-2 detects corrosion by measuring the ratio of resistance between exposed and protected metal elements mounted on a probe that extends into the corrosive medium or sample. As the exposed metal is corroded, the resistance ratio between the two elements increases. This increase is a direct indication of corrosion. Since both elements are mounted together, resistance changes due to temperature fluctuations have no effect on the readings. In the Model L-2, the two metal elements in the probe form two legs of a bridge circuit, with a servo-driven potentiometer acting as the automatic balancing mechanism. The gear train connecting the servo motor and the balancing potentiometer also drives the recorder output potentiometer. Corrosion totalizer dials on the face of the instrument indicate how many microinches of corrosion have occurred. During multiple test operation, the Model L-2 cycles from one probe to the next on a programmed basis. Approximately one minute is provided for balancing and printing at each station. The slope of the resulting curves is an indication of the corrosion rate, while the total travel of the recorder pen is a measure of the corrosion that has taken place.

Finnish Paper Engineers Plan Symposium

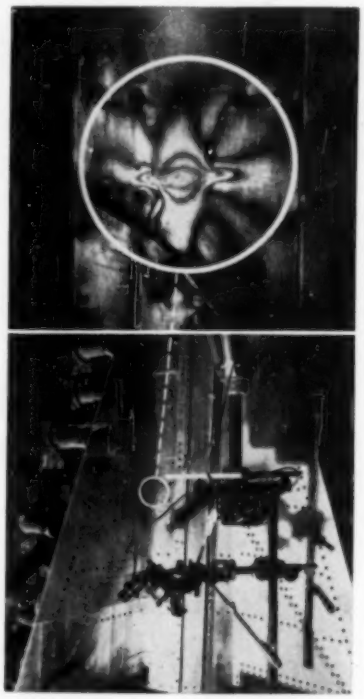
The Finnish Paper Engineers' Association will sponsor a Symposium on Statistical Methods in the Pulp and Paper Industry in Helsinki May 16-18, 1960, under the supervision of the EUCEPA organization.

Persons who are planning to present papers at the Symposium are asked to submit the title of their paper immediately, an abstract before Oct. 15, 1959, and the complete paper before Jan. 15, 1960.

The purpose of these meetings is to bring together only specialists (50 to 150 in number) to consider some specific problem. So far there has been only two symposia, in 1958 in Darmstadt, Germany—Cellulose Analysis, and in 1959 in Nordwijk, Holland—Straw Pulp; but several others are planned, covering topics such as the printability of paper, paper testing, stream pollution, etc.

An organizing committee, with Professor Waldemar Jensen as chairman, has been appointed. For further information, contact Nils J. Lindberg, general secretary of the symposium, the Finnish Paper Mills Association, Helsinki, Finland.

EUCEPA—Comité Européen de Liaison pour la Cellulose et le Papier—was formed three years ago by the Western European Associations (or research centres or technical institutions in countries which have no local associations) in the pulp and paper field. The executive committee of EUCEPA consists of the presidents of the local associations.



P-9-14—PhotoStress, a new quantitative stress analysis tool which converts strain into colors, is now available. Materials Research Engineers and Quality Control Engineers may use PhotoStress to check stress distribution and stress flow on aircraft and missile parts and similar items. PhotoStress is a transparent, birefringent (doubly refractive) plastic which can be applied to an actual part to be stress analyzed as flat sheet, formed sheet or a liquid. When the part to which PhotoStress is bonded is subjected to strain, the plastic follows the deformation of the part. When PhotoStress is deformed, even minutely, it becomes birefringent—shows two sets of fringes under polarized light. Black fringes give the directions of principal strains while color fringes give the magnitude of principal strains in the part being stress analyzed. The plastic, therefore, behaves like an infinite number of tiny strain gages uniformly distributed over the part. PhotoStress instruments must be used to obtain quantitative data from the fringe patterns.

New Literature Available

L-9-1—A descriptive bulletin covering the design and use of the Perimeter is now available. This device instantly detects excessive hand perspiration to assist in assigning personnel to jobs and reducing defects from corrosion. The flashlight size unit consists of a handle with a built in power source and a meter. The circuit remains open until it is closed when the handle is contacted over a large area, as when it is grasped by the hand. The meter deflection indicates the concentration of the perspiration when present.

Monode, Incorporated, Among ASQC Convention Exhibitors

Monode, Inc., was among the exhibitors at the Thirteenth Annual ASQC Convention in Cleveland, Ohio, May 25-27, 1959.

Due to an oversight, Monode of Cleveland was omitted from the "Convention Exhibitor's List" in the July issue of *Industrial Quality Control*.

Monode produces equipment that would be of interest to QC engineers concerned with 100 percent inspection. Watch for the Monode Electronic Inspection Eye description, which will appear in the October issue.

L-7-8—A 1959 condensed catalog of Veeder-Root counters is now available. Included in this catalog are the new High Speed Electronic Counters made by Veeder-Root's electronic controls division as well as some of the products of the instrument-type counter division.

♦ ♦ ♦

L-7-9—A must for business and industry executives is the new brochure "Supervisory Growth" recently released by The Elliott Service Co., Inc. The brochure contains a number of management information tools.

♦ ♦ ♦

L-9-3—Catalog No. 61 has been issued by Jones Motrola Corp. giving detailed technical data regarding Jones Hand Tachometers, Models 1600, 3200, 4800, 1HT and 3HT. Also contained are descriptions of sizes and ranges available, price information and information on standard accessories available for all Jones Hand Tachometers.

♦ ♦ ♦

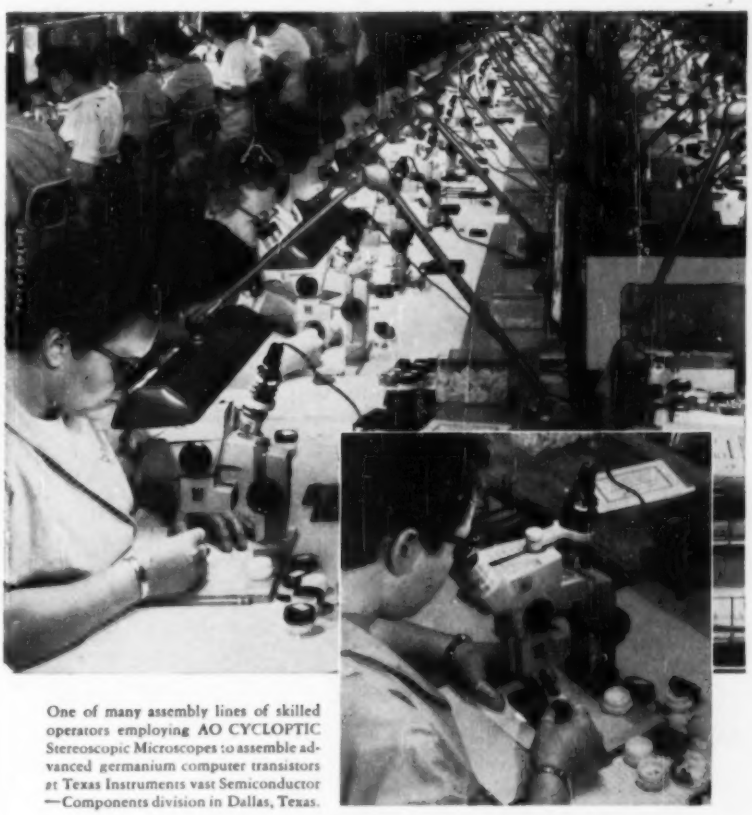
L-9-4—An eight-page manual entitled "Keys To Bearing Fits" containing instructions on preventing premature bearing failures and off-schedule removals; procedures on obtaining accurate bearing fits easily and economically; and engineering data assuring perfect bearing fits on all anti-friction bearings, is now available from Bearing Inspection, Inc.

♦ ♦ ♦

L-9-5—How to continuously determine silica traces down to 0.001 ppm is explained in a new methodology sheet published by Technicon Controls, Inc. describing use of the company's Auto-Analyzer continuous automatic analysis equipment.

♦ ♦ ♦

L-9-6—The Thwing-Albert Instrument Company announces the publication of Bulletin 1051-TA describing the T-A-C Tester and its operation, application, and advantages as a laboratory means of quickly and easily checking the suitability of an adhesive to an adherent under simulated production-use conditions.



One of many assembly lines of skilled operators employing AO CYCLOPTIC Stereoscopic Microscopes to assemble advanced germanium computer transistors at Texas Instruments vast Semiconductor—Components division in Dallas, Texas.

Here's how Texas Instruments mass produces precision transistors

with AO's CYCLOPTIC Microscope

Precision assembly of minute components for transistor production offers no problem to the skilled workers at Texas Instruments. Using the AO CYCLOPTIC Stereoscopic Microscope, material that is practically invisible to the eye assumes accurately magnified proportions...the entire assembly operation is observed in crisp, erect, three-dimensional detail.

Bright, shadowless lighting is beamed deep inside the small unit apertures with AO's exclusive Vertical Illuminator attachment. The instrument's remarkable long working distance assures the operator of complete freedom of movement and affords ample room to accommodate larger objects and assembly tools.

With the instrument body inclined at a 30° angle, the operator can work in a natural, more comfortable position.

When manufacturing small precision assemblies... many progressive companies such as TI, depend upon the AO CYCLOPTIC to render the unit in visual "working size" dimensions.

If you have a particular production situation that 3-D magnification would help, why not discuss it with a capable AO Sales Representative. He can recommend the AO CYCLOPTIC Stereoscopic Microscope that will certainly solve your individual problem. There is no obligation, of course.

American Optical Company

INSTRUMENT DIVISION BUFFALO 15, NEW YORK

Dept. U248

☐ Please have AO Sales Representative demonstrate the AO CYCLOPTIC Microscope.

☐ Please send AO CYCLOPTIC Brochure SB66.

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American Society for Quality Control

Literature Classification System

METHODOLOGY OR TECHNIQUES CLASSIFICATION

000: General

100: Statistical Process Control
- 110: Control Charts
  - 111: Control Charts for Variables
  - 112: Control Charts for Attributes
- 120: Specifications, Tolerances, and Process Capabilities
- 130: Frequency Distributions in Process Control

200: Sampling Principles and Plans
- 210: Principles of Sampling
  - 211: Bulk Materials
  - 212: Discrete Units
  - 213: Classification of Characteristics
- 220: Sampling Plans
  - 221: Selection of Proper Sampling Plan
  - 222: Attributes Plans
  - 223: Variables Plans
  - 224: Continuous Plans
- 230: Censuses and Surveys

300: Management of Quality Control
- 310: Initiation of Quality Control
- 320: Training in Quality Control
- 330: Organization for Quality Control
  - 331: Quality Control Personnel
- 340: Administrative Techniques in Quality Control
  - 341: Records and Reports of Quality
  - 342: Standards and Procedures
  - 343: Incentive Plans
- 350: Economics of Quality
  - 351: Customer-Vendor Relations
  - 352: Quality Standards

400: Mathematical Statistics and Probability Theory
- 410: Theory of Estimation and Statistical Inference
- 420: Properties of Distribution Functions
  - 421: Normal Distribution
  - 422: Poisson Distribution
  - 423: Binomial Distributions
  - 424: Composite Distributions
- 430: Probability Theory

500: Experimentation and Correlation
- 510: Tests of Significance and Confidence Intervals
- 520: Design and Analysis of Experiments
  - 521: Planning the Experiment
  - 522: Experimental Designs
  - 523: Special Methods for Analysis of Data
- 530: Correlation
  - 531: Simple Correlation
  - 532: Multiple Correlation
  - 533: Rank Correlation
  - 534: Covariance Analysis
- 540: Curve Fitting
  - 541: Linear Regression
  - 542: Non-Linear Regression
  - 543: Multiple Regression
  - 544: Orthogonal Polynomials
  - 545: Time Series
- 550: Short-Cut Methods of Analysis
  - 551: Non-Parametric Tests
  - 552: Graphical Analysis of Data

600: Managerial Applications
- 610: Operations Research Methods
  - 611: Collection of Operational Data
  - 612: Special Techniques and Their Application
  - 613: Systems Analysis
- 620: Industrial Engineering Methods
  - 621: Packaging and Shipping
  - 622: Scheduling and Control (Production, Inventory, etc.)
  - 623: Work Measurement and Wage Plans
  - 625: Facilities Replacement
- 630: Business Economics Methods
  - 631: Measurement and Analysis
  - 632: Forecasting
  - 633: Financial Policy
  - 634: Sales Control

700: Measurement and Control
- 710: Measurement of Quality Characteristics
  - 711: Physical Properties
  - 712: Dynamic Properties
  - 713: Structural Properties
  - 714: Chemical Properties
  - 715: Atomic and Nuclear Properties
  - 716: Aging and Deterioration
- 720: Process Control
- 730: Data Collection, Reduction and Processing
- 740: Automation

800: Reliability
- 810: Management of Reliability Function
  - 811: Organization
  - 812: Training and Indoctrination
  - 813: Implementation
  - 814: Value Analysis
  - 815: Specifications and Contracts
  - 816: Procurement Relations
  - 817: Trade-Off Evaluations
- 820: Mathematical Theory of Reliability
  - 821: Probability and Prediction Theory
  - 822: Reliability Distribution Functions
  - 823: Life Testing Theory
  - 824: Estimating and Assessment
  - 825: Apportionment
- 830: Design
  - 831: Systems Reliability Analysis
  - 832: Human Engineering
  - 833: Part Selection, Analysis and Standardization
  - 834: Maintenance Engineering
  - 835: Configuration Standardization
  - 836: Design Reviews
- 840: Methods of Reliability Analysis
  - 841: Data Collection
  - 842: Data Reduction
  - 843: Data Processing
  - 844: Modes of Failure
- 850: Demonstration
  - 851: Testing Methods
  - 852: Usage
- 860: Field Activity
  - 861: Training and Operations
  - 862: Maintenance
  - 863: Logistics
  - 864: Reporting

900: Open

FUNCTIONAL CLASSIFICATION

:00:	**General**	
:10:	**Management**	Those functions which direct the activities of an organization.
:20:	**Production**	Those functions with a marketable product.
:30:	**Financial**	Those functions dealing with monetary aspects of an organization.
:40:	**Procurement**	Those functions obtaining materiel for an organization.
:50:	**Sales**	Those functions marketing and servicing the product of an organization.
:60:	**Engineering**	Those functions establishing the requirements and standards of actual or potential marketable product.
:70:	**Quality**	Those functions assuring that product conforms to requirements and standards.
:80:	**Industrial Relations**	Those functions dealing with the personnel and community relations aspects of an organization.
:90:	**Management Services**	Those functions dealing with the systems and services employed by an organizational complex.

INDUSTRY AND BUSINESS CLASSIFICATION

:000—General or Non-Classifiable Establishments
- :000—General
- :099—Non-classifiable

:100—Agriculture, forestry, and fisheries
- :101—Commercial farms
- :102—Non-commercial farms
- :107—Agricultural services and hunting and trapping
- :108—Forestry
- :109—Fisheries

:200—Mining
- :210—Metal mining
- :211—Anthracite mining
- :212—Bituminous coal and lignite mining
- :213—Crude petroleum and natural gas
- :214—Mining and quarrying of nonmetallic minerals except fuels

:300—Contract construction

:400—Manufacturing
- :419—Ordnance and accessories
- :420—Food and kindred products
- :421—Tobacco manufactures
- :422—Textile mill products
- :423—Apparel and other finished products made from fabrics and similar materials
- :424—Lumber and wood products, except furniture
- :425—Furniture and fixtures
- :426—Paper and allied products
- :427—Printing, publishing, and allied industries
- :428—Chemicals and allied products
- :429—Petroleum refining and related industries
- :430—Rubber and miscellaneous plastics products
- .431—Leather and leather products
- :432—Stone, clay and glass products
- :433—Primary metal industries
- :434—Fabricated metal products, except ordnance, machinery and transportation equipment
- :435—Machinery, except electrical
- :436—Electrical machinery, equipment, and supplies
- :437—Transportation equipment
- :438—Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks
- :439—Miscellaneous manufacturing industries

:500—Transportation, communication, electric, gas and sanitary services
- :540—Railroad transportation
- :541—Local and suburban transit and interurban passenger transportation
- :542—Motor freight transportation and warehousing
- :544—Water transportation
- :545—Transportation by air
- :546—Pipe line transportation
- :547—Transportation services
- :548—Communication
- :549—Electric, gas, and sanitary services

:600—Wholesale and retail trade
- :650—Wholesale trade
- :652—Retail trade—building materials, hardware, and farm equipment
- :653—Retail trade—general merchandise
- :654—Retail trade—food
- :655—Automotive dealers and gasoline service stations
- :656—Retail trade—apparel and accessories
- :657—Retail trade—furniture, home furnishings, and equipment
- :658—Retail trade—eating and drinking places
- :659—Retail trade—miscellaneous retail stores

:700—Finance, insurance, and real estate
- :760—Banking
- :761—Credit agencies other than banks
- :762—Security and commodity brokers, dealers, exchanges and services
- :763—Insurance carriers
- :764—Insurance agents, brokers, and service
- :765—Real estate
- :766—Combinations of real estate, insurance, loans, law offices
- :767—Holding and other investment companies

:800—Services
- 370—Hotels, rooming houses, camps, and other lodging places
- .72—Personal services
- .373—Miscellaneous business services
- .875—Automobile repair, automobile services, and garages
- :876—Miscellaneous repair services
- :878—Motion pictures
- :879—Amusement and recreation services, except motion pictures
- :880—Medical and other health services
- :881—Legal services
- :882—Educational services
- :884—Museums, art galleries, botanical and zoological gardens
- :886—Nonprofit membership organizations
- :888—Private households
- :889—Miscellaneous services

:900—Government
- :991—Federal government
- :992—State government
- :993—Local government
- :994—International government

Locating an Article

As an example, an article coded 111:60:433 would refer to an article on "Control charts for variables—used in the engineering function—of the primary metal industry."

The first three digits (111:) refer to the Methodology or Techniques Classification, the second two digits (:60:) refer to the Functional Classification, and the last three digits (:433:) refer to the Industry or Business Classification.

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Contact Mark E. Ocker, conference coordinator, Purdue University Division of Adult Education, Lafayette, Ind.

QC Symposium October 6-8 at Tinker AFB

Management personnel from industry and leading quality personnel of the military departments in the Oklahoma City Air Materiel Area will attend a Quality Control Management symposium at Tinker Air Force Base, Okla., Oct. 6-8.

The symposium was announced by Colonel Louis G. Thorup, chief of the OCAMA Quality Control Office. Major speakers and their subjects are: R. E. Ledbetter, General Electric, "Important Aspects of Engine Reliability"; Everett H. Dale, Minneapolis-Honeywell, "A Management Plan"; Colonel Richard Stolle, Headquarters AMC, "Preventive Approach to Quality Control"; and J. M. Scanlon, General Electric, "Engineering Talent in Quality Control."

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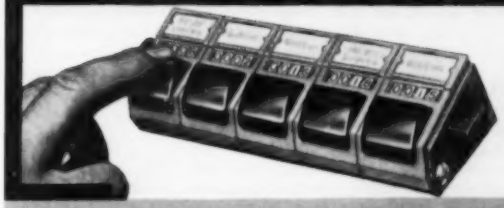

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section briefs

AKRON-CANTON . . . The most important event of July was the installation of officers for the coming year. They are chairman—Robert Dorn, Timkens; vice chairman—L. A. Bedford, Goodyear; secretary—Wally Siff, General Tire; and treasurer—D. C. Dague, Hoover Company.

The October meeting will be held Oct. 15 at Lacomini's in Akron. Dr. Julian W. Toulouse, a QC consultant, Operations Research, Toledo, Ohio, will speak on, "Finding the Facts Before Setting the Specifications."

ALBUQUERQUE . . . Section meetings will resume in September, when the speaker will be Charles A. Bicking of the Carborundum Co. The vice president and program chairman, J. C. Gaskins, ACF Industries, has done an excellent job in arranging a complete program for the 1959-60 season.

ALLENTOWN-BETHLEHEM . . . An executive meeting was held July 28 at Hotel Traylor in Allentown. Section finances were discussed and a report was made giving the current status of membership. It was decided to give an award to the three top Keymen who bring out the members in their group to meetings and other functions. Speakers and other plans for the year's meetings were discussed at great length. A report was made on the courses that will be offered in fall and winter sessions at both Allentown and Reading.

The Saddoris award standing was briefly discussed and ways to improve the standing were decided upon. The coming picnic was discussed and it was decided to hold it at the same location as last year on Aug. 28. The budget for the coming year was discussed. It was decided that the members of the executive committee will estimate their needs for their area of operation and submit them for purposes of budgeting.

Refreshments were served and the meeting was adjourned.

BALTIMORE . . . New officers will hold an executive committee meeting at the Faculty Club of the Johns Hopkins University. The agenda will include the working out of the program for the new year.

Educational sessions are planned prior to the regular meetings designed to present fundamentals and administrative aspects of statistical QC. Dolph Taylor, our secretary, is in charge of the educational program. Nine meetings are scheduled, including seminars on reliability.

Work will begin on tentative plans to contact top management people in the Baltimore area in order to acquaint them with our role in industry. The objective will be to have their firms participate more actively in the society.

BINGHAMTON . . . The September meeting will include a plant tour of Link Aviation, Inc., Hillcrest, N. Y. The arrangements committee is finalizing the plans in hopes of making this visitation a most pleasant and interesting one.

Metals Committee Plans Meeting in Philadelphia

The 23rd regular meeting of the Metals Technical Committee will be held in the Hotel Warwick, Philadelphia, Pa., Oct. 22-23, 1959.

The agenda includes meetings of the regular subcommittees, problem seminar, and a tour of the Alan Wood Steel Corp. All members are urged to attend. Those interested in the basic manufacture, shaping and treating of metals, and the fabrication of products customarily included in the operation of an integrated metal-producing company are also cordially invited to attend.

BIRMINGHAM . . . Outgoing officers for the past year—Clyde T. Comer, chairman, and Robert E. Spruiell, program vice chairman, met with newly elected officers for the 1959-60 season—A. D. Phillips, chairman, and C. Donovan Brown, program vice chairman.

The dinner-meeting was held June 18 at the Holiday Inn in Bessemer. Plans for the coming year were discussed and the general feeling was that we should go all out in stimulating better attendance and interest by providing nationally known speakers for one or possibly two of our meetings. The published speakers list should prove very helpful.

To date, the coming year's program is scheduled except for the months of January and March. We hope to have these dates filled by the end of August.

Section activities will start with the Quality Control Conference Oct. 15 and 16, at the University of Alabama. This conference is sponsored by district sections of which the Birmingham section is one.

BOSTON . . . Committee work during the past weeks has been in membership, program, education and organization areas. John Donald reports over 150 renewals up to July 31. This is the hard core of really active members—the ones who "get something" out of their membership in the Boston section (see Significant Differences, for example).

Our first meeting of the year features two "Big Names." In the afternoon of Sept. 2, Dr. H. C. Hamaker, chief statistician, Phillips Research Laboratories, Eindhoven, Holland will speak. He will be followed after dinner by Dr. A. V. Feigenbaum of General Electric.

Fabian reports the fall basic course starts Wednesday, Oct. 7., to run for six consecutive Wednesdays. This course is designed for anyone who wants an "introduction" to QC. The courses have been most successful for the past twelve years as preparation (limbering-up the mental muscles) for regular courses offered by colleges in the Boston area. Fred Ryan reports the Merrimac Valley subsection's first speaker is August B. Mundel of Sonotone, Sept. 17, Thursday.

CHARLESTON . . . The first meeting of the 1959-60 season will be held Sept. 17, in the assembly room of the Charleston Engineers and Scientists Society in the Kanawha Hotel. "Accuracy and Precision of Industrial Tests and Analyses," will be the topic of the speaker, James A. Mitchell, Tennessee Eastman.

CHICAGO . . . Officers for 1959-60 are Howard Jones, chairman; Robert Majewski, vice chairman; James Fizzell, program; Frank Berman, membership; Mae Goodwin Tarver, secretary, and James Kennedy, treasurer.

The section is repeating its basic education and advance training program in statistical QC, contact James Fizzell, Illinois Testing Laboratories, 420 N. LaSalle St., Chicago 10, Ill.

CINCINNATI . . . The section's first executive committee meeting for the 1959-60 business year year was held on July 22. Chairman-elect Ray Hauck's resignation was discussed and accepted. Ray, who has accepted a position with Armour Research Foundation in Chicago, Ill., will be missed by the section and its members. Vice chairman-elect Bill Eilrich will take over the chairmanship as provided in the section's constitution. The executive committee then selected secretary-elect Robert N. Johnson as vice chairman and Jim Christy as section secretary. Ed Edelmann, treasurer elect, will continue as the section treasurer. The section's program is nearing completion and we are looking forward to a successful year.

The October technical meeting will be a joint meeting with a number of local professional societies scheduled to attend. The presentation of "The Cutting Edge" by the DoAll Company will be very appropriate for this joint meeting.

CLEVELAND . . . The executive committee met July 31 to continue the organizing of plans for the coming year. The program for the coming year was approved. It contains nine monthly meetings, one joint meeting and two plant tours. The educational committee will have three programs this year—two this fall and one in the spring. Exact starting date of the fall programs can be obtained by calling Harry Wadsworth, Statistics Department, Western Reserve University. Another decision was to publish the section's first yearbook. It is hoped to have the yearbook distributed to the members before the first meeting.

DALLAS-FORT WORTH . . . On July 9, 38 members and 54 guests enjoyed a plant tour of Chance Vought Aircraft in Grand Prairie. After being welcomed by J. P. Luby, who is also a member of the section, the group was escorted through the plant by members of Chance Vought's Quality Control Department. They were then taken into the projection room, where they were shown a Walt Disney film, "Man in Space," after which refreshments were served in the cafeteria.

All of the Texas sections are looking forward to seeing Jack Gant again in October. Jack visited the four Texas sections in March 1958 when he came as a substitute speaker. This year he will discuss "Blueprint and Measurement Repeatability."

GEORGIA . . . The section will visit the Owens-Illinois Atlanta Plant in Hapeville, Ga., Oct. 9, to observe the manufacture of glass containers. Dr. J. H. Toulouse of Toledo, Ohio, will be the speaker.

GREATER DETROIT . . . The education committee will conduct the following eight week courses during the fall semester beginning early in October.

Course I—Statistical Quality Control (a basic course in statistical QC fundamentals and methods).

Course III—Methods of statistical Analysis (applications to the field of QC for those who have had course I and II or equivalent.).

These courses are available to ASQC members and to the public for training in statistical control techniques.

Classes are held in the Veterans' Memorial Building, Jefferson Ave., Detroit, from 7 to 10 p.m., Monday and Tuesday evenings. Total hours, each course—24 hours. Course fee, each course—$15 for ASQC members, $25 for non-members.

The American Institute of Electrical Engineers Awards the Lamme Medal to P. L. Alger, Fellow

P. L. Alger, an ASQC Fellow with the Albany section, has been awarded the AIEE Lamme Medal.

The medal was presented during the Institute's Summer and Pacific General Meeting, with the citation, "In recognition of their contribution to the art and science of design and application of rotating electric machines."

Mr. Alger, who is an adjunct professor of electrical engineering at Rensselaer Polytechnic Institute, is also a Fellow in the American Society of Mechanical Engineers and the American Association for the Advancement of Science, and a member of the Institution of Electrical Engineers, the Societie des Electriciens Francaise, American Society for Engineering Education, American Mathematical Society, the National Society of Professional Engineers, the National Municipal League, and the American Legion.

The author of some 40 papers in the AIEE *Transactions*, Mr. Alger has written two books: *"The Nature of Polyphase Induction Machines*, John Wiley & Sons, Inc., 1951; and *Mathematics for Science and Engineering*, McGraw-Hill, 1957.

He has also contributed to the *General Electric Review*, the *Standard Handbook for Electrical Engineers*, and other publications.

He is a past chairman of the AIEE Committees on Rotating Machinery, Technical Program, and Professional Conduct, and of several of the Standards co-ordinating committees and working groups. He served as a director of the Institute from 1944 to 1948. Currently he is chairman of the Ethics Committee of the Engineers' Council for Professional Development, a director of the New York State Citizens' Council and the Schenectady Bureau of Municipal Research.

Mr. Alger was born in Washington, D.C., Jan. 27, 1894. He was graduated from St. John's College, Md., in 1912, and from the Massachusetts Institute of Technology (MIT) in 1915.

Before he joined General Electric in 1919, he served as Lieutenant in the Ordnance Department, U.S. Army, at the Sandy Hook and Aberdeen Proving Ground.

At GE he served as an engineer in the induction motor department, where he studied under Dr. E. J. Berg at Union College, receiving his M.S. degree in 1920. In 1927 he was appointed assistant engineer in the a-c engineering department, where he was concerned with the design of the Conowingo generators and other large machines.

In 1930, he became staff assistant to the vice president of engineering, where he was engaged for 20 years in the promotion and co-ordination of engineering work throughout the company. In 1950, he was appointed a consulting engineer in the motor department, where he remained until his retirement from GE on Feb. 1, 1959.

Mr. Alger was awarded the medal jointly with Sterling Beckwith, who has served as assistant engineer with the Metropolitan Water District of Southern California, Allis-Chalmers Mfgr. Co., in Milwaukee, Wis., and since 1952 as a consulting engineer on such projects as generator cooling, transportation of liquefied natural gas at minus 258 F, fixation of nitrogen in an internal combustion engine, and improved refrigeration of fresh foods at 110 percent relative humidity.

This was the first year since its institution in 1928 that the Lamme Medal has been awarded jointly.

It was also awarded to Sterling Beckwith, holder of over 40 patents and author of 12 technical articles. He is co-author of the Synchronous Machine Section of the *Standard Handbook for Electrical Engineers*. Since 1942, he has participated on nine AIEE Committees and five ASA Committees.

He is a member of the CIGRE (Conference Internationale des Grandes Reseaux Electriques), Sigma Xi, Tau Beta Pi, Eta Kappa Nu, and the Milwaukee Engineer's Society. He is a registered professional engineer in Wisconsin and Illinois.

Tulsa is Now a Saddoris Award Master Section

Another section has joined the listing of Saddoris Award Winners.

Tulsa is now listed as a Master section in the 1958-59 Competition. It had been omitted in the original listing due to an error in scoring.

The error developed when retroactive points for October 1958 were entered in section III—renewals, but were not included in the totals in the lower part of the sheet.

William A. Golomski and his Saddoris Award Committee wishes to thank members of the Tulsa section for their enthusiastic support of the Saddoris Award Competition.

For applications or further information, write to Morris M. Lightstone, education committee chairman, 116 Westbourne, Birmingham, Mich.

GREATER MUSKEGON . . . The program planning board met twice in July at the Black Angus Restaurant in Grand Haven, Mich. At the time of the second meeting, the board had two-thirds of the program lined up.

Members of the program committee are Bill Hume, Albert Baker, Lester Shaw, Joe Uerina, Elwood Presley, William Poe and Larry Long.

HAMILTON-MIDDLETON . . . The main speaker for the September dinner-meeting was John W. Gower, attorney at law, Dayton, Ohio. Mr. Gower, a graduate of Carnegie Tech in industrial engineering, and the University of Cincinnati in law, is a practicing lawyer and a senior member of ASQC. Mr. Gower spoke on company responsibility for product quality.

A "coffee talk" was also presented during the program by Detective Elmer Robish of the Cincinnati Vice Control bureau. Mr. Robish, a veteran of twenty years with the Cincinnati Police department, presented a short discussion on narcotics.

HARRISBURG . . . The executive committee of the Harrisburg section met at the Caterpillar Tractor Co., July 23. An excellent combination of plant tours, speakers and business sessions has been arranged for the coming year.

The first meeting of the new year will be held 8 p.m. Oct. 7, at the Lancaster, Pa., plant of the Armstrong Cork Co. A tour of the plant at 4 p.m. will precede dinner at 6:30 p.m. in the plant cafeteria. The speaker for the evening, H. A. Reehling, should get the year off to a rousing start with his talk on "QC at Armstrong."

INDIANAPOLIS . . . The second annual survey is almost complete and the proposed section roster to make more meaningful our slogan "Meet More Members and Communicate Between Meetings," is taking shape. Most rewarding is the interest shown in committee work.

The 1959-60 advisory board members are ASQC Director Thomas Turner, Dr. Irving Burr, Dr. Charles Hicks, Virgil Alexander, Francis Bucksot and Past President John Waldner.

The October meeting (see the Section Calendar) will be a tour of Western Electric's Indianapolis shops. H. G. Ross, works manager, will welcome the group, and Miss Bonnie B. Small, Allentown Department Chief, will speak on "In-plant Training." This is a joint meeting with the people we want on the "Quality Control Team" at our places of business, the American Society of Training Directors.

KANSAS CITY . . . A program planning session was held July 30 at the Black Angus during which the schedule for the new year was discussed.

LOS ANGELES . . . During July section officers were busy preparing groundwork for a new sub-section of the Los Angeles section. This new sub-section is to be known as the Orange County Sub-section and will cover the new industrial areas around Fullerton, Anaheim, Santa Ana, Newport Beach, and Costa Mesa. William F. (Bill) Hurst has been assigned as the area coordinator and has contacted the major industries in the area.

The membership potential, when fully tapped, should result in better than 200 members by the time full Sectional status is reached, probably in 1961.

At the first organizational meeting, such high-powered ASQC personalities as Harry Romig, Frank Squires, Ed Coleman, Henry Matosoff, etc., will outline the details of organizing and the benefits of belonging to the Society. The Los Angeles section will provide about 60 members by transfer, with about 60 coming in as new members. The Los Angeles section recognizes the need for decentralization due to the vastness of the industrial area.

LOUISVILLE . . . Fourteen members of the section, consisting of the officers and committee chairmen, met at Jimmy Lynn's Restaurant for a dinner meeting. After dinner, Mr. Rottman began the meeting by reading all the new communications from the ASQC office. The Midwest ASQC Conference, which is to be in nearby French Lick, Indiana, was discussed in detail. Ned Miles reports that plans for transportation facilities are nearly completed for out of town members arriving in Louisville who will need rides to the Conference.

The executive committee decided that since response to the dinner meetings was so encouraging last year, the first three meetings of this year would be dinner meetings. The committee is considering having this type of meeting every month.

When Mr. Rottman called for reports, the nine chairmen reported plans made, or already working, for a successful year.

Plans are being made for a joint meeting with the Lexington, Ky., section. This will consist in a tour through IBM at Lexington, followed by a dinner meeting with a guest speaker from IBM. It is hoped that these plans materialize in time for our December meeting.

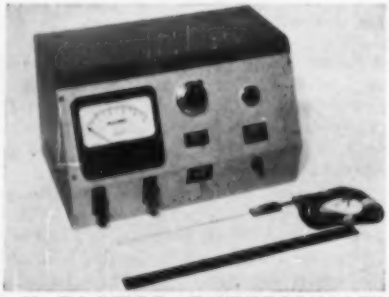
METROPOLITAN . . . September 12 marks the 11th annual Rutgers All Day Conference to be held at Rutgers University, New Brunswick, N.J.

On Sept. 28, the monthly meeting will be held at the National Cash Register Auditorium in New York at 7:45 p.m. The subjects will be "More Effective Quality Control in Packaging and Packaging materials," presented by Tom Budne, and "Process Control through Acceptance Sampling by Variables," by Mr. M. Geller.

On Oct. 28, the monthly meeting will be held in the Flight Room at Roosevelt Raceway Shopping Center in Long Island at 7:45 p.m. The subject will be "Reliability," presented by W. Bidermann and Mr. W. Rombach.

MID HUDSON . . . During the month of July there were no section meetings. Instead, there were a number of committee meetings held to plan and organize the programs and events for the coming season. A very interesting slate of programs has been scheduled.

A FAST-PRECISE TEST



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MILWAUKEE . . . The October meeting of the Milwaukee section will consist of a plant tour of the Oscar Mayer Company in Madison, Wis. Following the tour, the group will dine in the plant cafeteria and then hear a talk by Oscar Mayer plant manager A. Paul Bowman. Mr. Bowman, a senior member of the Milwaukee section, ASQC, will speak on "What Top Management Expects of QC."

MINNESOTA . . . Section officers, past and present, make a good proportion of the recent section news. In addition to the three mentioned in Significant Differences this month, we have Don Greb, chairman in 1950, returning to Minnesota from Westinghouse in Pittsburgh to speak at the October meeting. Don Baron, a past section chairman and formerly director of QC engineering, Temperature Controls Division, Minneapolis-Honeywell in Minneapolis, has left the section for the position of quality manager, temperature controls, Honeywell in Chicago.

Minneapolis-Honeywell, which takes a big place in our news this issue, takes an equally big place in the section's management for the current year. Of the fifteen directors, officers and committee chairmen, nine work at local plants of this manufacturer.

MONTREAL . . . Officers for the 1959-60 season are Doug Guthrie, chairman; Frank Clow, vice chairman; Larry Gauthier, secretary-treasurer, and Claude Taylor, immediate past chairman.

The initial meeting of the Montreal section 1959-60 activities will take place Sept. 24, at the Molson Brewery.

On Oct. 24th, the Annual All-Day Forum will be held at the Ecole Polytechnique of the University of Montreal. An attendance of more than 200 persons is expected.

MUNCIE . . . The executive committee met July 30 and completed the program for the coming year. The first meeting of the new fiscal year will be Management Night in September. Guest speaker E. P. Spence will talk on "What Management Expects from Quality Control."

NEW HAMPSHIRE . . . The section will again co-sponsor with the University of New Hampshire Extension Service a basic course in industrial quality control.

The 30-hour course will be similar to the spring course and will be offered in Durham, Nashua, Keene, Claremont and Laconia. Members of the ASQC will again serve as instructors. The course will run simultaneously in all cities with sufficient registration and will commence the week of Sept. 21. Certificates will be awarded at a banquet concluding the course and attended by all the students and instructors. The New Hampshire section is especially grateful to Dorian Shainan for his commencement address to 70 graduates last spring.

NORTHEAST TENNESSEE . . . Dr. Hubert H. Hill, chairman, and several members of the Northeast Tennessee section attended a talk by Dr. Wernher Von Braun July 24, in Johnson City, Tenn. Dr. Von Braun spoke on "Space and What We Are Doing About It." The talk was one of a series of presentations by the National Science Foundation Institute at East Tennessee State College.

The Statistical QC section of Raytheon in Bristol presented an eight hour course in "Control Charts and Charting" to all Raytheon inspectors and inspection supervisors. The course was successfully completed in July by all who attended. All instructors and several students are active members of the Northeast Tennessee Section of the ASQC.

NORTHEASTERN INDIANA . . . Newly elected chairman, Art Carter, met July 14 with the past officers and newly elected officers. They are Ellis Cash, vice chairman; Harry Richardson, secretary, and Howard Spicer, treasurer.

The following committee chairmen were appointed: Ed Bird, program; Joe Cline, past president and director of the Midwest Conference; Ray Snider, education; Dick Smith, publicity; M. Comerford, technical advisor; Ed Cade, historical; H. Brenner, Saddoris Award; Fred McKinney, membership, and Henry Dempsey, auditor.

Plans were finalized for the first meeting of the 1959-60 season to be held in September. A tour of the Falstaff Brewery was scheduled. The tour will be followed by a social meeting. Plans were also completed for the educational and technical programs for the new season.

PARKERSBURG . . . Former vice chairman Larry Parker has been installed as chairman of the Parkersburg section due to the transfer of Rue R. Wesley. Our loss will be Niagara Falls gain and Rue will be missed by this section. Leon Maurer has been appointed vice chairman of the section for 1959-60.

The section's kick-off meeting for the new year will be a get acquainted affair. It will be held 6:30 p.m. Sept. 22, at Peace Memorial, Route 31, north of Parkersburg, W. Va. Refreshments will be served. All friends of ASQC are cordially invited by the Parkersburg section.

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William T. Kirby

It is with deepest regret that the Pittsfield section reports the sudden passing of William T. Kirby on July 22, 1959. Mr. Kirby, a member of our section for many years, was employed as a chemist with the Crane Co., Dalton, Mass.

PENSACOLA-MOBILE . . . The first meeting of the season will be held Sept. 22, at the Brookley AFB, Officer's Club. A social period will be held from 6:30 to 7 p.m., after which dinner will be served.

The speaker for the evening will be Mr. B. Berger, assistant superintendent, reliability and engineering services, Western Electric Co. The title of the talk is "Coded Memory Trouble Shooting." Mr. Berger is planning to supplement his talk with an electronic display. The presentation will last between 30 and 45 minutes, and it is anticipated that it will be interesting and informative.

Since this is the first meeting of the season, all members are especially invited to attend. From past experience we all know that the food at the Officers' Club is par excellent. An enjoyable, as well as a rewarding evening, can be expected by all who attend.

PHILADELPHIA . . . The section will hold its first meeting for the new year in October.

PORTLAND . . . Past executive committee meetings have indicated that the Portland section will stress the need for QC to management this coming year. This will be done by joint meetings and possibly by a committee designed to provide answers to management on QC problems they encounter.

The full development of the advisory committee has not been finalized but its formation is beyond the talking stage. The future of the section appears to be entering into an up-swing in membership and activity and the new executive committee hopes to push beyond present borders.

Welcome to all of the new members.

RHODE ISLAND . . . The executive council held three sessions in July to plan the speakers and educational program for the new year. Council meetings will be held on Oct. 5.

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ROCHESTER . . . Cuyler J. Hawkes has accepted the chairmanship of a committee which will study the section's constitution and by-laws in order that they may be brought into line with the recently revised ASQC Constitution.

SAN ANTONIO . . . The executive committee met in July to discuss and officially close out the business affairs of the section for the past term. All business matters were turned over to the new officers. Best of luck, fellas!

The section is anxiously awaiting the start of the new season which begins in September. Ken Davidson, Texas Instruments, will be the feature speaker for this meeting.

SAN BERNARDINO . . . The Section is honored to have three papers selected for presentation at the Western Regional Conference at Phoenix. They will be presented by Walter R. Kuzman of Minneapolis-Honeywell Corp., Ordnance Division; Norman R. Garner of Aerojet General Corp., and Samuel Zancuff of Aerojet General Corp.

SAN DIEGO . . . Considering the tremendous success of the installation dinner dance at the Kona Kai Club on Shelter Island last month it is quite apparent that our San Diego Section is "off and running" with much enthusiasm for the coming year. The dance was real "cool" under the stars, with our usual San Diego balmy weather prevailing. A well done is in order for the outgoing officers who made such a wonderful evening possible.

The Del Mar Racing season has come and gone so now those section members who devised the perfect statistical system (pony type) may now retreat to their distribution curves and find out what went wrong. Better luck next season, fellows!

As you will note from our schedule of events for the coming year, the role of the small vendors in our San Diego industrial community is to be emphasized. This will certainly lead to an increase in section membership. Adios Amigos.

SAN FRANCISCO . . . The executive committee met July 13, at the United Airlines Maintenance Base, San Francisco Airport. Under the direction of Chairman Stan Hotchner, plans were made for the coming season's program which will include a variety of subjects from professionalism to sampling. An educational TV series presenting QC at work is being considered as a part of this year's activities. Franklin H. Hunsicker, Continental Can, briefed the group on arrangements for the 1960 National Convention which will be hosted by the San Francisco section.

At the season's first meeting on August 4, Lester P. Gideon, Hughes Aircraft Company, addressed the group on "Professionalism in the Western Region." Mr. Gideon, Chairman of the group which recently completed a professionalism survey of QC personnel in the Western Region, elaborated on the survey which included salary, education, experience and other comparisons.

The Sixth Annual San Francisco Bay Area QC Conference was held Sept. 17, at Stanford University. The conference was jointly sponsored by the section and the Stanford Industrial Engineering Dept. Lyle Connell, Westinghouse Electric, was the Conference chairman.

ST. LOUIS . . . The Chemical Division and the St. Louis section is jointly sponsoring a two-day course in Evolutionary Operation to be taught by the experts—Stuart Hunter and Truman Koehler. The course will be held at the Inorganic Chemicals Division Research Laboratories of Monsanto Chemical Co., Oct. 12 and 13.

The EVOP couse will be followed by the annual "St. Louis Conference" on Oct. 14. This meeting will be held at the Falstaff Brewing Co. There will be six technical papers, divided into two lines, one technical, the other administrative.

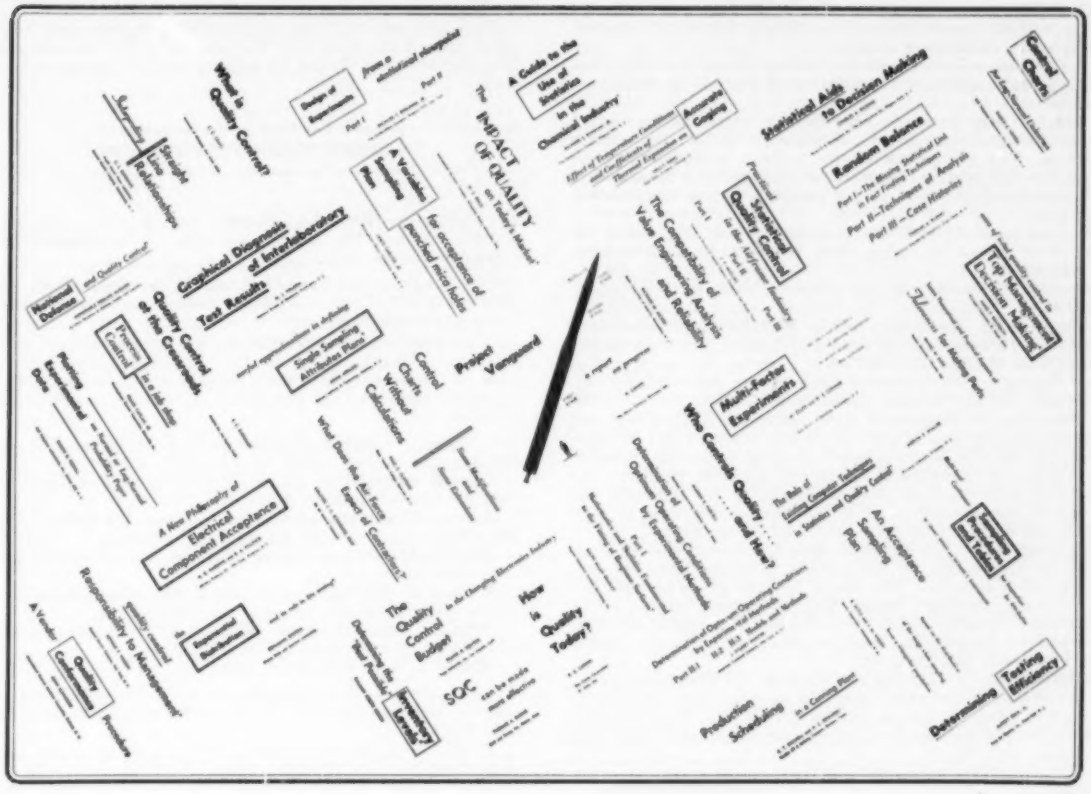
The St. Louis section has been designated by the Midwest Conference Board to present the 16th Midwest Quality Control Conference in 1961. The planning committee has been organized and has commenced its activities. The conference will be held in the fall, exact dates to be announced in the near future. Plan to be with us in 1961.

TOLEDO . . . Three organizational meetings were held to acquaint new officers and committee chairmen with assignments and to outline the program for 1959-60. The proposed schedule of events was met with enthusiastic response. An innovation this year is the Toulouse Award, in honor of Dr. Julian Toulouse, for outstanding accomplishment by a Toledo section member.

Officers for the coming year are: chairman—T. R. Meyer, Owens-Illinois Glass Co.; vice chairman—Joseph A. Ivan, Johns-Mansville; secretary—Margaret Tobin, Textileather; treasurer—Harlan Radiker, M & S Manufacturing; and Directors Jack Schneider, Electric Auto Lite; Beatrice Dorn, Doehler-Jarvis Div., and John Meeker, Johns-Mansville.

TORONTO . . . During July, the executive and various committees have been extremely busy organizing a program for the coming year. One of the highlights scheduled for Sept.

The Brumbaugh Award Committee Can't Pick the Winner at Random . . .


What is Quality Control?
Design of Experiments
Part I
Part II
A Guide to the Use of Statistics in the Chemical Industry
The IMPACT OF QUALITY on Today's Markets
Accurate Coding
Statistical Aids to Decision Making
Control Charts
Random Balance
Part I—The Basic Statistical Unit in Fast Fraime Technique
Part II—Technique of Analysis
Part III—Case Histories
A Variables Sampling Plan
for acceptance of punched mica flakes
Statistical Quality Control in the Lithium Industry
Part I
Part II
Part III
The Compatibility of Value Engineering Analysis and Reliability
Graphical Diagnosis of Interlaboratory Test Results
Quality Control at the Crossroads
Process Control
Single Sampling Attributes Plans
Control Charts Without Calculations
Project Vanguard
a report on progress
Multi-Factor Experiments
Who Controls Quality . . . and How?
Determination of Optimum Operating Conditions by Experimental Methods
Part I
Part II
Part III
The Role of Existing Computer Techniques in Statistics and Quality Control
An Acceptance Sampling Plan
Random Numbers and Tables
Trap Maintenance in Pest Control
Planning Experimental Data
A New Philosophy of Electrical Component Acceptance
What Does the Air Force Expect of Contractors?
Responsibility to Management
Incremental Distribution
Quality Control
Procedure
The Quality Control Budget
How is Quality Today?
Determining the Reliable Inventory Level
SQC
can be made more effective
Production Scheduling
Determining
Testing Efficiency

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Cuyler J. Hawkes, Chairman, the Brumbaugh Award Committee:

To give recognition to the most deserving article in IQC, July 1958 through June 1959, I nominate:

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TITLE

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AUTHOR

This article nominated by:

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NAME

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ADDRESS

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— Entry Deadline Date November 1, 1959 —

23, is a plant tour through the facilities of the P. L. Robertson Co., Milton, Ontario, a prominent screw manufacturer. A large turnout is expected.

Three discussions on Study Group Meetings are included in the 1959-60 agenda. This is a new trend, but found successful by other sections in Canada.

In October everyone will be looking forward to the tour through the Studebaker Corporation of Canada at Hamilton, Ontario.

UTICA . . . On Tuesday, June 23, the executive committee of the Utica section met to discuss the forthcoming year's program. The group was happy to hear that the program committee had received answers from all prospective speakers and that plans for the coming year's program were almost completed.

A joint meeting with the Syracuse section is planned for July 22 to discuss the joint clinic that will be held in Syracuse this year.

The Oct. 11 meeting will be a joint meeting with the AIIE.

WACO . . . Officers for the 1959-60 season are George H. Halsey, section chairman; Edwin F. Moore, vice-chairman; Samuel E. Patrick, secretary, and Richard A. Crow, treasurer.

WESTERN MASSACHUSETTS . . . During the early part of July the executive committee met at the Sheraton-Kimball and plans for the coming season were firmed. C. W. Carter will organize the program of eight meetings; H. Edelstein will organize a basic course and an all-day clinic on QC Management; G. Peletier is to represent the section in the Connecticut Valley of Technical Societies; S. Lezinski is to run the publicity and Saddoris Award function; A. Donnelly has charge of membership; with L. Dunphy as treasurer, G. Laybourne as secretary, and C. Baumann as chairman.

Starting Sept. 28, a 12 week basic QC course will be sponsored by the section in conjunction with the Massachusetts University Extension. The course will be given at Chicopee high school, Chicopee, Mass. The instructors are to be H. Edelstein of Stanley Home Products and S. Lezinski of Bigelow-Sanford Carpet Co. Both are members of this section. The Iown text will be used.

WORCESTER . . . During the summer the officers and committee chairmen have been actively engaged in an attempt to bring the program and activities for the 1959-60 year into shape. At this writing the program for the monthly meetings is well underway, and only a few dates are left to be filled. The education committee under the direction of Nasim David has already scheduled a ten session course this fall to be given by Len Seder and Dorian Shainin.

It is planned to have the season's program open with a plant tour of the Reed Roll Thread Co., in the late afternoon. The tour will be followed by a dinner and QC movie at Nick's Grill.

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SIGNIFICANT DIFFERENCES

. . . Baltimore—**Russell G. Hotter**, vice chairman, formerly of Proctor Electric Co., is now with the Westinghouse Electric Corp., Baltimore, Md.

. . . Binghamton—**John Schneider**, formerly with IBM, Endicott, N.Y., is now with the operations research department at Owego, N.Y.

. . . Birmingham—**C. Donovan Brown**, former special project engineer and QC supervisor, Line Material Industries, Division of McGraw-Edison Co., Birmingham, was recently appointed manager of industrial engineering and quality control.

. . . Boston—**Walter F. Bosse** is now with Amperex Electronics, Inc., in Hicksville, Long Island, N.Y.

Dean E. Bensley has a new job in industrial engineering at Raytheon Co., Waltham, Mass.

Edward N. Gordon is now a QC engineer for Sylvania Electric Products, Needham, Mass.

John M. Morrison is now chief inspector at the Reece Corp., Waltham, Mass.

William H. Sellers, General Electric Co., Lynn, Mass., is now in the reliability and technical support group.

John W. Beach is now a QC engineer in the data systems operations of Sylvania in Needham, Mass.

Arthur I. Heim has moved to Schick.

. . . Charleston—**M. A. Aitken** and **H. L. Babcock** have been named co-directors of QC for Union Carbide's South Charleston plant.

B. M. Berg has been promoted to staff manager of the Union Carbide Development Dept.

New section officers for the 1959-60 season are **M. A. Aitken**, chairman, Union Carbide; **W. E. Sticklen**, vice chairman, C & P Telephone; **P. T. McCoy**, secretary, Union Carbide, and **W. R. Kellogg**, treasurer, Monsanto.

. . . Chicago—Congratulations to **Rolland Frakes** on his new position with the Celanese Corp. Rolland was chairman of the Chicago section's sub-group in Calumet this past year.

. . . Cincinnati—**George Krenek**, supervisor of quality engineering for General Electric, has accepted a new position in the rocket engine section.

Jack L. Mairose is now operation research manager for the Drackett Co., Cincinnati.

Ed Kelly has a new position with AVCO, Cincinnati, and has transferred from the Richmond, Ind., section to the Cincinnati section.

Harry H. Herman Jr., has returned from military duty and has rejoined the Schenley Distillers, Inc., in their QC department.

. . . Dallas-Fort Worth—Plans are nearing completion for the forthcoming Seventh Aircraft and Missiles Division Conference to be held in Dallas, Nov. 19 and 20, 1959.

. . . Georgia—**Professor A. Clifford Cohen Jr.**, has been named director of the newly established University of Georgia Institute of Statistics in Athens, Ga.

. . . Indianapolis—**Keith E. Ross**, formerly chief inspector, RBM Div., Essex Wire Corp., Logansport, is now QC manager with the Columbus Process Co., Inc., Columbus, Ind.

Senior Past President **Tom Turner** is now ASQC section aid chairman for 15 sections. If you are making a trip to any of these areas, phone Tom at Diamond Chain for a "Good Samaritan" assignment. The sections are Indianapolis, Richmond, Muncie, Rockford, Milwaukee, Winnebago, Racine, Minnesota, Iowa, Chicago, St. Charles, Central Illinois, Kankakee-Joliet, Evansville-Owensboro, and Lexington.

. . . State University of Iowa—**Professor Lloyd A. Knowler**, chairman of the department of mathematics and astronomy, State University of Iowa, became a Trustee of Teacher's Insurance and Annuity Association for a term of four years in an election by the policy holders. Our sincere congratulations to Dr. Knowler on the deserved distinction this election confers on him.

. . . Lexington—General Inspection Foreman Archie H. Dedman and Inspection Foreman William C. Akers, U.S. Army Signal Depot, Lexington, have received superior performance citations and cash awards for the development and installation of Demerit QC Plans in the inspection operations of the Signal Depot.

. . . Los Angeles—**David A. Hill,** Fellow in ASQC, District 16 Representative 1958-59, and a very active member in ASQC, has been promoted from Director of the Reliability and Quality General Office, Hughes Aircraft Co., to president of the Santa Barbara Research Center, a Hughes subsidiary.

William F. (Bill) Hurst, formerly QC Director for Hallamore Electronics in Anaheim, Calif., is now director of QC for Leach Corp., in Compton, Calif. Bill is the area director for the organization of the new Orange County subsection of the LA section.

E. Jack Lancaster, membership chairman, Ballistic Missile Center, is back and is now traveling to Europe. We hear that his secretary, phone (office) SP 6-1311, Ext. 1714, is the real membership chairman and that Jack is only a figurehead. Anyway, our membership should jump considerably with such an able man (er, lady) in office.

Don R. Andree, formerly of Hughes Aircraft, is now Administrator of Reliability and Quality, RCA, Santa Monica, Calif.

. . . Milwaukee—**A. Paul Bowman,** a senior member of the Milwaukee section, has been promoted to the position of manager of the Madison plant of Oscar Mayer and Co. Mr. Bowman was previously the operations manager of the Madison plant.

Philip E. Dakin, Miller Brewing Co., has been named the liaison officer for the American Society of Brewing Chemists to the ASQC.

. . . Minnesota—**Harold Guide,** former section chairman, has been appointed director of QC engineering, Temperature Controls Division, Minneapolis Plant, Minneapolis-Honeywell Co.

Byron W. (Bill) Brown, section secretary, is sporting a brand new Ph. D. from the University of Minnesota.

Richard J. Keefe, section chairman, has moved from Remington Rand Univac, St. Paul, to reliability engineer, semiconductor Division, Minneapolis-Honeywell, Minneapolis.

We announce with regret the untimely passing of **Melvin Slind,** QC Engineer at the Toni Company and a universally respected friend.

. . . Muncie—This year's program is to include a ladies night, panel discussion by local members, a joint meeting, and guest speakers.

. . . Northeast Tennessee—**Dr. Hubert H. Hill,** section chairman, will speak Aug. 24 at the Gorden Research Conference on Statistics in Chemistry and Chemical Engineering. Dr. Hill's subject will be "Experimental Design to Adjust for Time Trends."

Mike Gomez, quality audit supervisor, Raytheon Co., Bristol, Tenn., has been promoted to section head, inspection section.

. . . Pensacola-Mobile—**Lt. Col. James R. Forrester,** former chief of the staff quality control office, Hqs. MOAMA, and past vice-commander of the Pensacola-Mobile section, has been appointed chief of the Dayton Air Procurement District.

Col. H. W. Randall Jr., has been appointed chief of the staff quality control office, Hqs. MOAMA.

New officers for 1959-60 are: chairman—**E. R. Pierson,** Chemstrand; vice chairman—**J. W. Comish,** Brookley AFB; secretary—**D. H. Danheisser,** Chemstrand, and treasurer—**L. J. Trahan,** International Paper Co.

Jack Comish, Brookley AFB, and **L. R. Henry,** Chemstrand, represented the Pensacola-Mobile section at a meeting at the University of Alabama. The meeting was called to help plan the Southeastern ASQC Industrial Conference.

. . . Philadelphia—The American Society for Testing Materials recently presented a Sam Tour Award of Merit for distinguished services to the Society, especially along technical lines, to **Herbert W. Stuart,** QC director, United States Pipe and Foundry Co., Burlington, N. J.

Dr. Morris Hamburg, associate professor of statistics, Wharton School, University of Pennsylvania, received a one year Ford Foundation Fellowship to attend the Institute of Basic Mathematics at Harvard University, Cambridge, Mass. Dr. Hamburg is past chairman of the Philadelphia section.

Arnold H. Cronshagen of the Signal Corps Supply Agency, Philadelphia, is presently with the Aerojet General Corp., Azusa, Calif., as QC engineer of the corporate reliability staff.

Jerry Braverman, section chairman, has joined the methods engineering branch as chief of the quality assurance section, Frankford Arsenal, Philadelphia.

. . . Rochester—**James C. Griffin** has been appointed QC director for Haloid Xerox Inc. This new position is intended to bring all QC functions at Haloid under one director.

. . . San Antonio—**William T. Smith,** has completed a three week course in advanced quality analysis at Dayton, Ohio. The course was sponsored by the USAF Institute of Technology in cooperation with the Ohio State University.

. . . San Francisco—**Bruno Filice,** Filice and Perrelli Canning Co., was elected vice chairman of the newly established Food and Related Industries Division at an organizational meeting of this group during the recent ASQC Convention in Cleveland.

Benjamin Epstein, visiting Professor of Statistics, Stanford University, was a member of the instructional staff of the industrial reliability course jointly sponsored by ASQC and the University of California and presented in Los Angeles, Aug. 3-14.

. . . St. Louis—The St. Louis section regrets to announce the death of **O. B. Sondag,** sales representative for Pratt and Whitney.

Paul K. Leatherman has accepted the position of materials engineer at Chrysler Motors in the Metropolitan St. Louis area.

. . . Toledo—Two active members of the Toledo section are to be congratulated on recent promotions. **Jack Schneider** has been advanced to assistant chief industrial engineer of Electric Auto Lite, and **Ray Crouse** has been made industrial engineer manager of the Dura Division of Detroit Harvester.

. . . Toronto—**Mr. S. Prout,** the newly appointed chairman of the educational committee, is looking forward to a very successful series of QC extension courses at the University of Toronto during the coming year. All arrangements and the course calendar are now completed.

. . . Western Massachusetts—**Bill Carter** has left Rath & Strong to go out on his own and offer his services as a consultant on quality and management controls. He is working out of Western Drive, Longmeadow, Mass. We wish Bill success in this venture.

. . . Worcester—**Nelson B. Grant** is currently manager of shop operations at the small steam turbine department of General Electric in Fitchburg, Mass. He was formerly QC manager in the same department.

Nasim David is presently affiliated with the Waltham Grinding Wheel Co., in Waltham, Mass., as QC manager.

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SECTION CALENDAR (AUGUST 25—SEPTEMBER 31)

SECTION	DATE	PLACE	TIME	SUBJECT	SPEAKER
Akron-Canton	Oct. 15	Iacomini's Restaurant	8:00 pm	Finding the Facts Before Setting the Specifications	Dr. J. W. Toulouse
Albuquerque	Sept. 21	Hospitality Room, Southern Union Gas Co.	8:00	Application of Industrial Statistics in R & D	Charles A. Bicking, The Carborundum Co.
	Oct. 12	Albuquerque Nat'd Bank, East Central Branch	8:00	Panel Discussion "Theory vs Practical QC"	Moderator—T. R. Harrison
Allentown-Bethlehem	Oct. 14	Berkshire Hotel Reading	8:00	Quality Control Procedures	J. T. Skelton, Caterpillar Tractor, York, Pa.
Boston	Oct. 1	MIT Faculity Club Penthouse	6:00	Statistical Methods in Engineering Design	E. B. Ferrell, B.T.L.
Cincinnati	Oct. 21	Engineering Society Building	8:00	The Cutting Edge	DoAll Co., Des Plaines, Ill.
Cleveland	Oct. 2	Cleveland Eng. & Scientific Center	8:00	Sequential Sampling—Its Use and Abuse	Dr. Gayle McElrath, University of Minnesota
	Oct. 22	Cleveland Graphite Bronze	7:00	Plant Tour	———
Dallas-Fort Worth	Oct. 29	Sky Chef Room, Amon Carter Airport	8:00	Blueprint and Measurement Repeatability	Jack S. Gant, General Electric Corp., Jet Engine Div., Cincinnati, Ohio
Georgia	Oct. 9	Owens-Illinois Atlanta Plant, Hapeville, Ga.	6:00	Need of Facts in Setting Specifications	Dr. J. H. Toulouse, Toledo, Ohio
Greater Muskegon	Oct. 8	Cumerford Restaurant, Holland, Mich.	6:30	Plant Tour—General Electric	———
Harrisburg	Oct. 7	Armstrong Cork Co., (Tour 4:00 pm) Lancaster, Pa.	6:30	Quality Control at Armstrong	H. A. Reehling
Indianapolis	Oct. 20	2525 Shadeland, Indianapolis, (Tour 3:30 pm)	7:00	In-Plant Training	H. G. Ross and Miss Bonnie B. Small
Kansas City	Oct. 22	Hallmark Cards, Inc.	6:30	Graphic Arts in Quality Control	Cliff Cutler, Hallmark Cards, Inc.
Lexington	Sept. 17	Lexington Signal Depot	7:00	Fundamental Applications of QC in the Chemical Industry	L. Kent Reitz, Eastman Kodak Co.
Los Angeles	Oct. 14	Carolina Pines Restaurant	6:00	Vendor-Vendee Relations	E. C. Bennett and Panel, Northrup Corp.
Metropolitan	Sept. 25	National Cash Register Auditorium, 50 Rockefeller Plaza, New York, N. Y.	7:45	More Effective Quality Control in Packaging and Packaging Materials Process Control Through Acceptance Sampling by Variables	Tom Budne M. Geller
	Oct. 28	Flight Room, Roosevelt Raceway Shopping Center, Long Island	7:45	Reliability	W. Bidermann and W. Rombach
Mid Hudson	Oct. 6	Nick Beni's Anchor Inn, Poughkeepsie	7:00	Design of Experiments, Operation Research	Dr. Leroy S. Brenna
Milwaukee	Oct. 19	Oscar Mayer Co., Madison, Wis.	4:00	Plant Tour	A. P. Bowman
Minnesota	Oct. 13	LeSueur Country Club	6:00	Quality Problems in Atomic Reactors	Donald J. Greb
Muncie	Oct. 15	Perfect Circle Plant, Richmond, Ind.	6:30	Plant Tour	———
Parkersburg	Sept. 22	Peace Memorial Park, Rt. 31 north of Parkersburg	6:30	Get-Acquainted Event	———
Pensacola	Oct. 20	Pensacola	6:30	QC As Related to Management and Employees	Simon Collier, Johns-Manville Corp.
Rhode Island	Oct. 15	Providence Engineering Society	8:00	Training Program for QC People	Miss Bonnie B. Small, Western Electric
San Antonio	Sept. 22	Hilton Hotel	8:00	To Be Announced	Ken Davidson, Texas Instruments
San Bernardino	Oct. 1	Mural House, Ontario, Calif.	6:30	Quality Control—A Production Necessity	J. Y. McClure, Convair, Fort Worth, Texas
St. Louis	Oct. 23	Golden Fried Chicken Loaf Restaurant	6:00	Statistical Thinking for Engineers Common Sense in Quality Control (Work Shop)	Professor C. P. Hicks, Purdue University Dr. P. K. Leatherman, Chrysler Motors
Toledo	Oct. 1	Lynn's	6:30	Joint Meeting with AIIE	———
Toronto	Oct. 7	University of Toronto, Electrical Building	8:00	Effectiveness of Control Charts	R. Schinn
	Oct. 26	Hamilton, Ontario	7:30	Plant Tour of Studebaker Corporation of Canada	———
Utica	Oct. 15	Hotel Hamilton	5:00	Fundamentals of Concepts of Statistical Analysis	Enoch B. Ferrell
Western Massachusetts	Oct. 13	Shelton Hotel, Springfield	6:30	Administration of a Quality Program	———
Worcester	Oct. 15	Worcester Polytechnic Institute	7:00	To Be Announced	———

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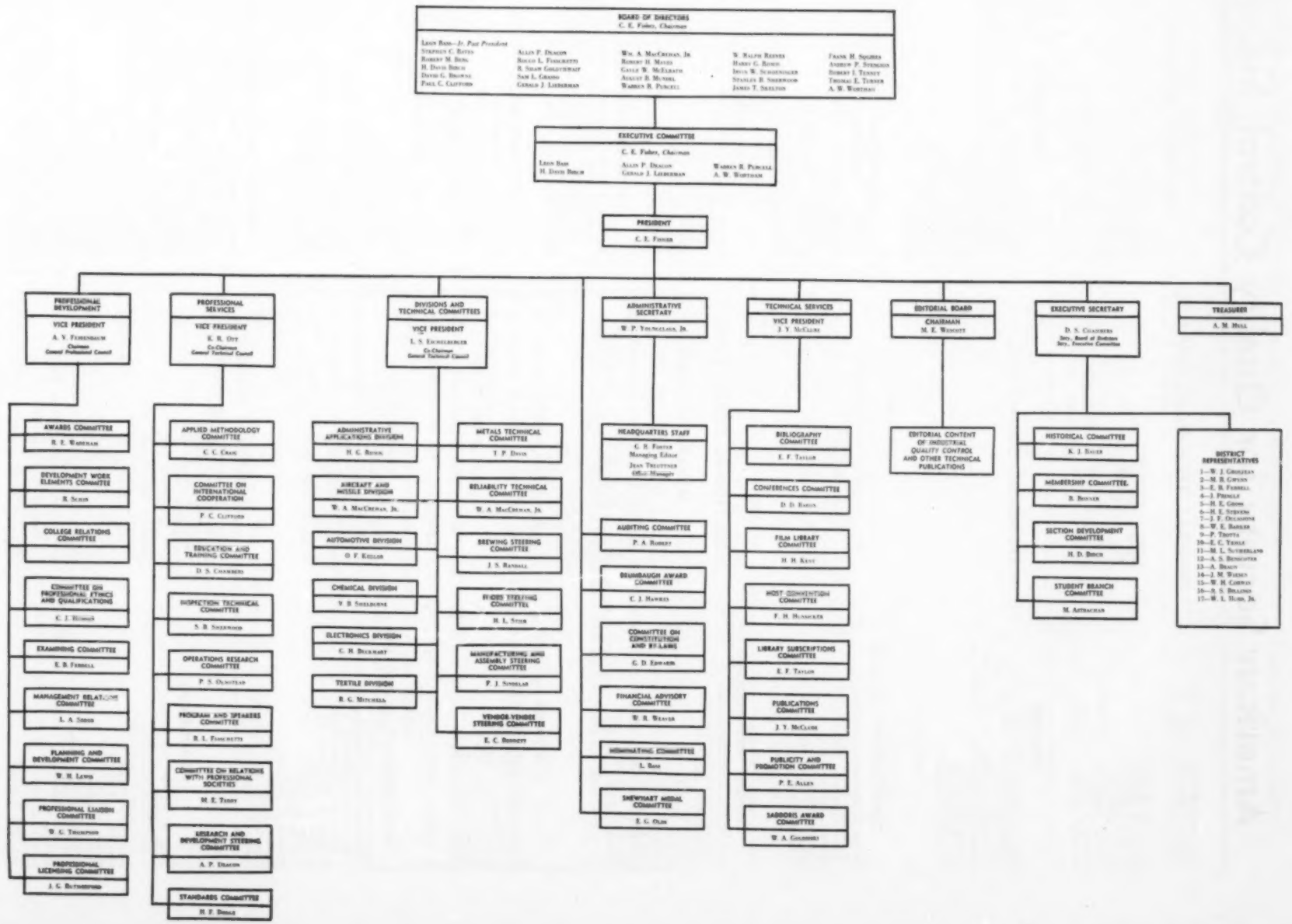
Organization Chart for 1959-60



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. . . **20-25**—14th Annual Conference and Exhibit of the Instrument Society of America, Chicago, Ill.

. . . ***24-25—Third Annual Technical Conference, Shamrock Hilton Hotel, Houston, Tex., sponsored by the Chemical Division, ASQC.***

OCTOBER

. . . **7**—Regional Technical Conference on Vinyl Plastics at the Cleveland Engineering Society Building, 3100 Chester Ave., Cleveland, Ohio, sponsored by the Cleveland section of the Society of Plastics Engineers, contact Mr. Pecktal, c/o Eastman Chemical Products, 13212 Shaker Square, Cleveland 20, Ohio.

. . . **11-16**—The Pacific Area National Meeting of the American Society for Testing Materials will be held at the Sheraton-Palace Hotel, San Francisco, Calif., contact ASTM, 1916 Race St., Philadelphia 3, Pa.

. . . ***12-14 and 23—The St. Louis section has planned a series of events. Oct. 12-13, an Evolutionary Operation Course will be conducted at 8:45 a.m. at the Monsanto Chemical Co., Creve Coeur, Mo., by J. Stuart Hunter, University of Wisconsin and Truman Koehler, American Cyanamid. Oct. 14, 9 a.m., the St. Louis Conference will be held at the Falstaff Brewing Co.***

. . . **13-14**—National Training Conference, "Progress in Plastics Engineering," the Ambassador Hotel, Los Angeles, Calif., sponsored by the Southern California Section of the Society of Plastics Engineers, contact Thomas A. Bissell, Society of Plastics Engineers, Inc., 65 Prospect Street, Stamford, Conn.

. . . **16**—Regional Technical Conference on Plastics Finishing and Decorating at the Hotel Niagara, Niagara Falls, N. Y.

. . . ***19-30—Reliability Training Course for Middle Management, Atlantic City, N. J., sponsored by the Professional Group on Reliability and Quality Control and the Electronics Division of ASQC, contact H. N. Hadley, 45 Martin St., South Acton, Mass.***

. . . **20-22**—The Tenth National Conference on Standards will be sponsored by the American Standards Association, Inc., at the Sheraton-Cadillac Hotel, Detroit, Mich., Contact the ASA, 70 East Forty-Fifth St., New York 17, N.Y.

. . . **22-23**—SQC Conference, Milan, Italy, sponsored by Italian Association for Quality Control, contact Segreteria del Convegno sul CSQ, Associazione Italiana per il Controllo della Qualita—Sezione di Milano, Piazza A. Diaz, 2, Milano, Italy.

. . . ***23-24—The 1959 Western Regional QC Conference will be sponsored by the Phoenix Valley of the Sun section at the Ramada Inn, Phoenix, Ariz., contact Dan Casky, conference chairman, 800 W. Butler Drive, Phoenix, Ariz.***

NOVEMBER

. . . **2-5**—11th Exposition of ARI, Atlantic City, N. J., sponsored by Air-Conditioning and Refrigeration Industry, 1346 Connecticut Ave., N.W., Washington 6, D. C.

. . . **4**—Regional Technical Conference on Plastics in the Shoe Industry at the Statler Hotel, St. Louis, sponsored by the St. Louis section of the Society of Plastics Engineers, Inc., contact Norman James, E. I. du Pont de Nemours & Co., Inc., 818 Olive St., St. Louis 1, Mo.

. . . ***4-6—The 13th New England QC Conference will be held at the Sheraton Biltmore Hotel, Providence, R.I., with the theme, "Quality Engineering Assures Reliability." A basic QC course will also be offered. Contact Wesley S. Cahagen, General Electric Co., Somersworth, N.H.***

. . . ***19-20—The Seventh Aircraft and Missiles Division Conference, Dallas, Tex.***

JANUARY

. . . **25-Feb. 4**—The 1960 Engineering and Management course for the professional development of managers and engineers will offer a choice of 22 subjects at the University of California, Los Angeles. Information on registration and living accommodations may be obtained from Reno R. Cole, College of Engineering, University of California, Los Angeles 24, Calif.

MAY

. . . **16-18**—Symposium on Statistical Methods in the Pulp and Paper Industry sponsored by the Finnish Paper Engineers' Association in Helsinki, contact Nils J. Lindberg, general secretary of the symposium, the Finnish Paper Mills Association, Helsinki, Finland.

BOOK REVIEWS

W. D. Baten, Editor

26 University Drive, East Lansing, Mich.

ELEMENTARY MATHEMATICAL PROGRAMMING, by Robert W. Metzger, John Wiley and Sons, Inc., New York, 1958, 246 pages, $5.95. Reviewed by Dean E. McKee, Agricultural Economist, ARS, USDA, Michigan State University.

The literature of mathematical programming tends to be widely scattered among many journals and bulletins. It varies from highly mathematical presentations of specific procedures to very general nontechnical discussions of the method.

For the most part, the books written to date on the subject, with a few notable exceptions, have been concerned primarily with the mathematics of programming procedures, and a rather high degree of competence in the field of mathematics is required if one is to be able to read them with understanding.

Mr. Metzger has attempted to write a book from which the non-mathematician can obtain a clear understanding of what is involved in applying some of the more commonly used procedures of mathematical programming. He has also indicated some of the areas in which they might be employed. The programming procedures he discusses are illustrated through extensive use of simplified numerical examples based on actual problems drawn from the field of operations research. These examples are carried through from the description of the problem to its solution and interpretation of the results obtained. Anyone having a command of college level algebra should have no difficulty in reading the book.

In chapter 1, Mr. Metzger presents a very brief description of the development of the field of operations research and the role of mathematical programming as one of the tools of analysis currently used in the field. Further, he points out that successful applications of mathematical programming have been made in the areas of 1) product allocation, 2) distribution and shipping, 3) market research, 4) job and salary evaluation, 5) blending of ingredients, 6) materials handling and 7) production planning. Illustrations of applications of programming methods in these areas are presented in later chapters in the book. The programming procedures discussed in this book include 1) methods for solving distribution problems, 2) simplex method, and 3) approximation methods.

The discussion of specific programming methods begins in chapter 2 with one of the simplest and most easily understood models in mathematical programming, the distribution model. In the literature of mathematical programming, this model is commonly referred to as the transportation model. Usually it applies to situations in which it is necessary to determine the allocation of customer orders among several sources of supply, for example, warehouses, so that the total cost of transportation or distribution is kept to a minimum. Several procedures for solving this problem once the data have been assembled are discussed. They include the stepping-stone method, the modified-distribution method (MODI) and Vogel's approximation method (VAM). Each of these procedures is simply a modification of the

computational steps involved in finding a solution to a particular type of problem or programming model. The discussion and explanation of the transportation model centers almost entirely around a simple numerical example without resorting to mathematical symbolism. This presentation leaves the reader with the impression that the transportation model is appropriate only for analyzing problems of product distribution or transportation which is not necessarily the case. Any problem that fits or can be made to fit the general mathematical characteristics of the transportation model can be solved as a transportation problem.

The simplex method, which is a method for solving more general models than the transportation model, is discussed in chapter 3. The treatment of the simplex method is somewhat more mathematical than the preceding discussion of the transportation model, but it is not particularly difficult to follow. This chapter contains a step-by-step description of how a linear programming problem is solved when the simplex method is used. A simple problem illustrates the method. Several variations in the problem are presented to illustrate how the method might be used in solving for different objectives. A solution to the problem is presented in terms of maximization of profits, maximization of machine utilization, and maximization of output.

Having illustrated the solution of a problem by the simplex method, Mr. Metzger takes up some of the refinements that might be made in the mathematical statement of the linear programming problem. This includes a discussion of the specification of minimum, approximate, and exact requirements which the solution of the problem must satisfy. He discusses also the case of degeneracy in the simplex method and how it is recognized and handled when encountered. The chapter concludes with a discussion of the dual problem and its relationship to the original statement of the problem.

The simplex method provides an exact solution to the problem stated but, as Mr. Metzger points out, in some instances, the cost of obtaining it may be greater than is justified. Frequently, approximations to the exact solution may be sufficient for the purposes at hand. In chapter 4, Mr. Metzger points our four general problem situations in which this may be the case and discusses several approximation methods that might be used. The index method is suggested as a simple and inexpensive way of obtaining an approximate solution to product allocation problems such as scheduling jobs on different machines in manufacturing. Another method discussed is called the nora method; it involves approximating the problem and solving it as a distribution problem. The chapter concludes with a discussion of approximate solutions to multi-dimensional distribution problems.

The rest of the book is devoted to a discussion of the analysis of typical problems for which programming procedures are used. These chapters emphasize the way in which the problem is formulated so that it can be solved by programming methods. In chapter 5, a somewhat more involved manufacturing problem is discussed, as well as an example of a blending problem.

Chapter 6 includes a brief discussion of computors and their use in mathematical programming. However, the discussion goes very little beyond naming some of the types of computors that could be used and a description of some of their characteristics. This chapter could well have been omitted from the book.

Chapter 7 is devoted entirely to the use of programming procedures in solving problems of production planning. The general problem is one of using information on monthly sales forecasts, monthly production capacity, and costs of production and inventory to arrive at an optimum production plan for the period ahead. The use of programming procedures in this way is illustrated in some detail by means of a rather comprehensive example.

Chapter 8 discusses the use of programming procedures for solving problems of stock slitting. In stock slitting, large stock rolls of material must be cut into a number of smaller widths, and the problem is to keep the trim waste to a minimum. Optimization of a nonautomated materials-handling system is discussed in chapter 9, and in chapter 10, some possible uses of programming procedures in job and salary evaluations are discussed.

Although the book concentrates to a large extent on the computational details of solving various types of programming problems, its scope is considerably broader than the usual computational handbook. By drawing upon actual problems for examples, Mr. Metzger has succeeded in showing some of the possible areas of application, as well as providing a basic understanding of the technique. Those who desire a general understanding of what mathematical programming is about should find this book helpful. Also, the beginning user of mathematical programming should find it quite informative.

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For advance registration, contact: Wesley S. Gahagen, General Electric Co., Somersworth, N. H.

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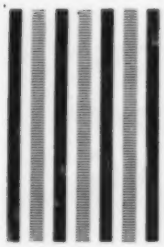

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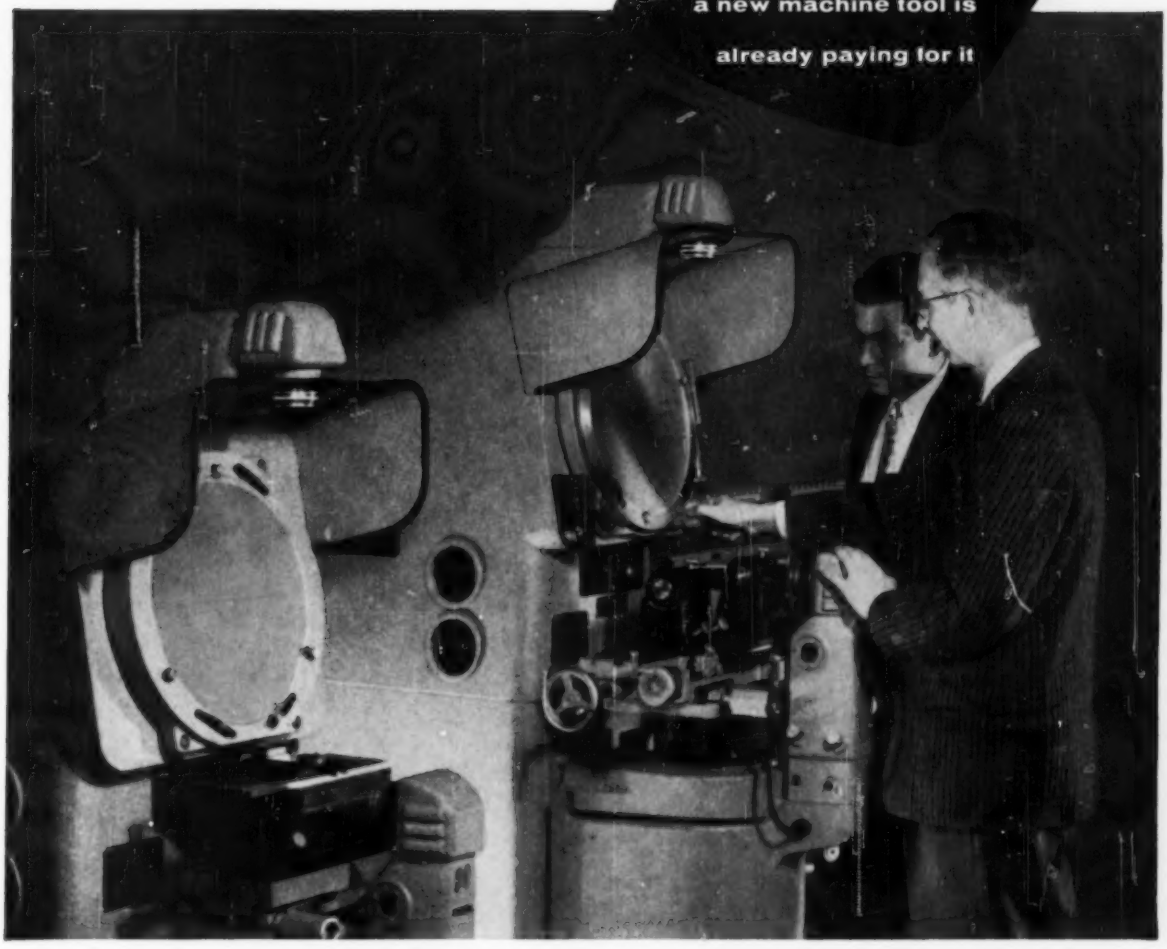

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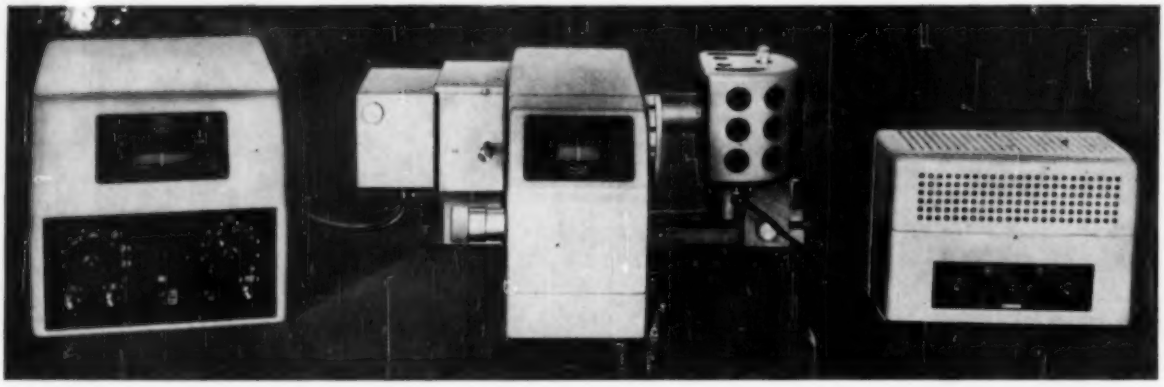

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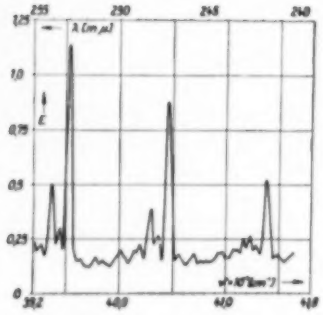

Extinction curve of benzine vapor

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